UNIVERSITY OF ILLINOIS

Agricultural Experiment Station

SOIL REPORT No. 21

McHENRY COUNTY SOILS

By J. G. MOSIER, R. W. DICKENSON, H. W. STEWART, E. VAN ALSTINE and H. J. SNIDER

Prepared for publication by L. H. SMITH

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IN RECOGNITION

The Soil Survey of Illinois was organized under the supervision of the late Dr. Cyril G. Hopkins. The work progressed for eighteen years under his guidance and the first eighteen soil reports bear his name as senior author. On October 6, 1919, Dr. Hopkins died in a foreign land in the service of the American Red Cross. It is the purpose to carry on to completion this great work of the Illinois Soil Survey in the spirit, and along the same general plan and lines of procedure, in which it was begun.

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INTRODUCTORY NOTE

It is a matter of common observation that soils vary tremendously in their productive power, depending upon their physical condition, their chemical composition, and their biological activities. For any comprehensive plan of soil improvement looking toward the permanent maintenance of our agricultural lands, a definite knowledge of the various existing kinds or types of soil is a first essential. It is the purpose of a soil survey to classify the various kinds of soil of a given area in such a manner as to permit definite characterization for description and for mapping. With the information that such a survey affords, every farmer or land owner of the surveyed area has at hand the basis for a rational system of improvement of his land. At the same time the Experiment Station is furnished an inventory of the soils of the state, upon which intelligently to base plans for those fundamental investigations so necessary for solving the problems of practical soil improvement.

This county soil report is one of a series reporting the results of the soil survey which, when completed, will cover the state of Illinois. Each county report is intended to be as nearly complete in itself as it is practicable to make it, even at the expense of some repetition. There is presented in the form of an Appendix a general discussion of the important principles of soil fertility, in order to help the farmer and land owner to understand the significance of the data furnished by the soil survey and to make intelligent application of the same in the maintenance and improvement of the land. In many cases it will be of advantage to study the Appendix in advance of the soil report proper.

Data from experiment fields representing the more extensive types of soil, and furnishing valuable information regarding effective practices in soil management, are embodied in form of a Supplement. This Supplement should be referred to in connection with the descriptions of the respective soil types found in the body of the report.

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McHENRY COUNTY SOILS

By J. G. MOSIER, R. W. DICKENSON, H. W. STEWART, E. VAN ALSTINE AND H. J. SNIDER

Prepared for publication by L. H. SMITH[1]

FORMATION

McHenry county is situated in the northern part of Illinois about 18 miles west of Lake Michigan. It lies in the Iowan and late Wisconsin glaciations, the latter covering the east three-fourths of the county. It has an area of 609.5 square miles.

During the Glacial period, snow and ice accumulated in the region of Labrador and to the west of Hudson Bay to such an extent that the mass pushed outward from these centers, chiefly southward, until a point was reached where it melted as rapidly as it advanced. In moving across the country the ice gathered up all sorts and sizes of material, including clay, silt, sand, gravel, small and large boulders, and even large masses of rock. Many of these were carried for hundreds of miles and the coarser materials were rubbed against surface rocks or against each other until largely ground into powder. When, thru the melting of the ice, the limit of advance was reached, the material carried by the glacier accumulated in a broad, undulating ridge or moraine. Much of the finer material was carried away in the drainage from the glacier and deposited on level outwash plains or over the flood plains of streams. When the ice melted more rapidly than the glacier advanced, the terminus of the glacier would recede and the material would be deposited somewhat irregularly over the area previously covered. This is known as the ground moraine, or intermorainal tract. A glacier receded and advanced a number of times, and with each advance another moraine was formed. The intermorainal tracts are now occupied chiefly by level, undulating, or slightly rolling plains.

The material transported by the glacier varied with the character of the rocks over which it passed. Granites, limestones, sandstones, shales, etc., were torn from their lodging places by the tremendous denuding power of the ice sheet and ground up together, the softer rocks disappearing first. A pressure of forty pounds per square inch is exerted by a mass of ice one hundred feet thick, and these ice sheets were hundreds or even thousands of feet in thickness. The materials carried along in the ice, especially the boulders and pebbles, became powerful agents for grinding and wearing away the surface over which the ice passed. Preglacial ridges and hills were rubbed down, valleys were filled with the debris, and the surface features were changed entirely. The mixture of material deposited by the glacier is known as boulder clay, till, glacial drift, or simply drift.

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[1]J. G. Mosier, in charge of soil survey mapping; R. W. Dickenson and H. W. Stewart, in charge of field party; E. Van Alstine, in charge of soil analysis; H. J. Snider, in charge of experiment fields; L. H. Smith, in charge of publications.

THE GLACIATIONS OF McHENRY COUNTY

The first glacier to cover McHenry county was the Illinoisan, which covered all of Illinois except the northwest county, the southern part of Calhoun county, and the seven southernmost counties. The deposit left by this glacier was covered by the deposit of subsequent glaciers, and therefore does not form the surface soil at any place in McHenry county. The next glacier was the Iowan, which covered the northeastern part of the state, but most of the deposit left by this was also covered by deposits from some of the later glaciers.

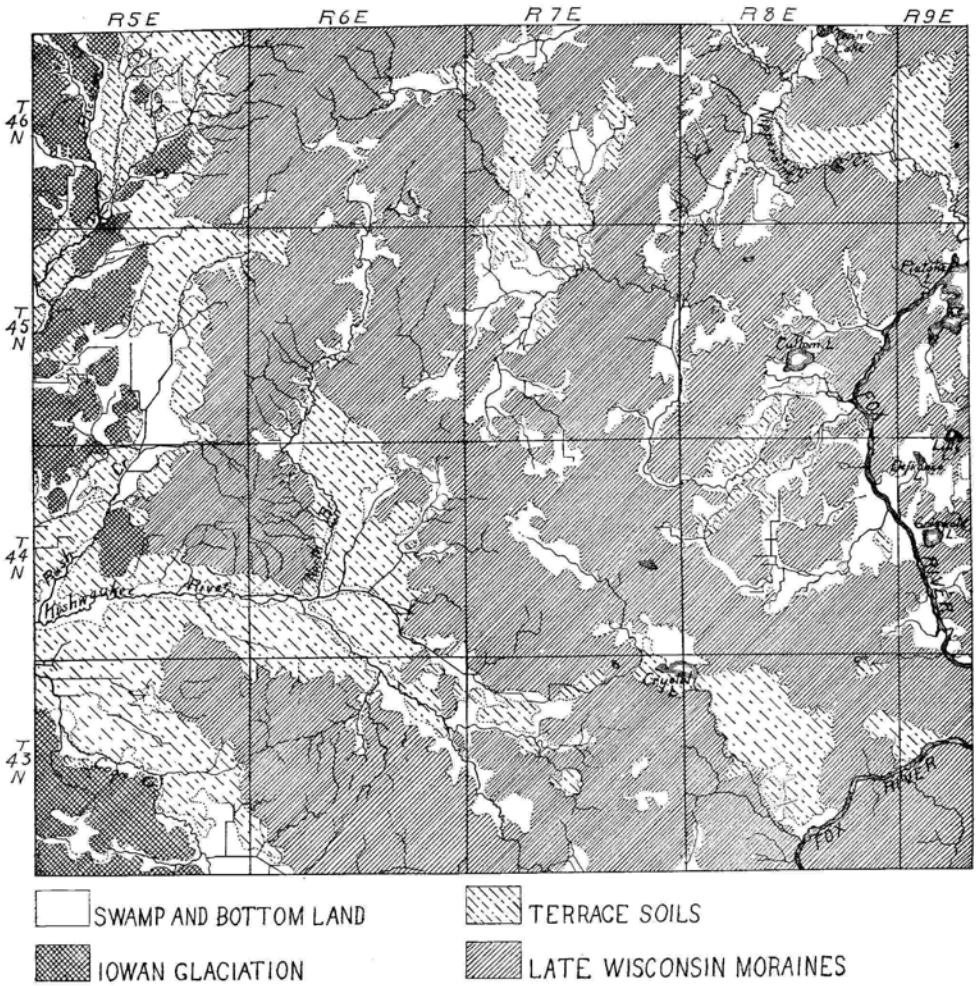
Two glaciations form the present surface deposits: the Iowan, and the late Wisconsin. The Iowan occurs in the western part of the county and covers the larger part of Town 46 North, Range 5 East; the west half of Town 45 North, Range 5 East; approximately the west four tiers of sections in Town 44 North; and a small area in the southwest part of the county in Town 43 North, Range 5 East. Without doubt the early Wisconsin glacier covered part of McHenry county, but the late Wisconsin has buried the early Wisconsin drift so that it cannot be distinguished. The late Wisconsin contains a very extensive morainic system known as the Valparaiso moraine. The drift in the county is rarely less than 50 feet in thickness, and the average depth is not less than 200 feet.

Large areas of gravel outwash, formed by broad, shallow, swift streams flowing from the melting glacier, and mapped as terraces, are found in the west and southwest parts of the county. Another large area occurs to the south of Hebron, another east of Spring Grove, and still another south of Crystal Lake. These terraces furnish large quantities of gravel that are very valuable for road material and concrete work. Much of the area of the county is covered by a thin layer of loessial or wind-blown material.

PHYSIOGRAPHY AND DRAINAGE

The county varies widely in topography, the terrace and swamp lands being generally level, while the upland, especially that of the late Wisconsin glaciation, is decidedly rolling. The variations are principally due to the irregular deposition of glacial material in the moraines. The morainic areas are characterized by a peculiar billowy appearance produced by the large number of rounded knobs, and kettle-holes, or basin-like depressions, that vary in depth from 2 or 3 feet to 50 feet or more and in diameter from a few rods to 20 rods. A few lakes are found, the largest of which is the Pistakee, which extends over from Lake county. Some rock outcrop occurs in the western part of the county along the Kishwaukee river. Many swamps are found all over the county, and the kettle-holes on the moraines are frequently occupied by ponds. The western part of the county is drained by the Kishwaukee and its tributaries, while the eastern is drained by the Fox river and the Nippersink creek.

The altitudes of some places in McHenry county are as follows: Alden, 964 feet above sea level; Algonquin, 760; Big Foot Prairie, 950; Cary, 811; Chemung, 877; Coral, 875; Coyne, 885; Crystal Lake, 922; Greenwood, 820; Harmony, 910; Hartland, 924; Harvard, 935; Hebron, 931; Huntley, 888; Johnsburg, 790; Lawrence, 896; McHenry, 770; Marengo, 819; Richmond, 815; Ridgefield, 928; Ringwood, 837; Solon Mills, 792; Spring Grove, 781; Terra Cotta, 807; Union, 836; Woodstock, 916.



MAP SHOWING THE DRAINAGE BASINS OF McHENRY COUNTY WITH MORAINAL, TERRACE, BOTTOM-LAND, AND SWAMP AREAS

SOIL MATERIAL AND SOIL TYPES

The soils of the Iowan glaciation are not formed from the glacial drift left by that glacier, but from a deposit of wind-blown or loessial material varying in depth from 3 to 8 feet. The area covered by the late Wisconsin glacier does not have such a deep deposit of loess, and in some cases the soil was formed directly from glacial material. Usually, however, the glacial material is not found until a depth of 18 to 24 inches is reached. A large number of small areas of gravelly loam occur, many of which are not large enough to be shown on the map.

In general the glacial material of these moraines contains much more gravel than is found in the counties to the south. The outwash sand and gravel plains have been covered with finer material to a depth of 20 to 50 inches and constitute excellent soils. About one-fourth of the area of the county is swamp and

bottom-land. The accumulation of organic matter on this area has gone on to such an extent that the soils are very rich in this constituent.

The soils of McHenry county are divided into the following classes:

(a) Upland Prairie Soils.—These are rich in organic matter. This land was originally covered with wild prairie grasses, the partially decayed roots of which have been the source of the organic matter. The flat prairie land contains a higher amount of this constituent than the undulating or rolling prairie, because the grasses and roots grew more luxuriantly there, and being saturated with water they were preserved from complete decay.

TABLE 1.—SOIL TYPES OF MCHENRY COUNTY, ILLINOIS

Soil type No.	Name of type	Area in square miles	Area in acres	Percent of total area
	(a) Upland Prairie Soils (700, 1000, 1200)			
-26	Brown silt loam	120.08	76,851	19.70
-60	Brown sandy loam	28.24	18,074	4.63
-90	Gravelly loam	4.73	3,027	.78
		153.05	97,952	25.11
	(b) Upland Timber Soils (700, 1000, 1200)			
-34	Yellow-gray silt loam	130.04	83,226	21.34
-35	Yellow silt loam	4.92	3,149	.81
-64	Yellow-gray sandy loam	43.82	28,045	7.19
-65	Yellow sandy loam	1.10	704	.18
		179.88	115,124	29.52
	(c) Terrace Soils (1500)			
1527	Brown silt loam over gravel	45.93	29,395	7.54
1526.4	Brown silt loam on gravel	6.81	4,358	1.12
1525	Black silt loam	1.67	1,069	.27
1566	Brown sandy loam over gravel	8.41	5,382	1.38
1560.4	Brown sandy loam on gravel	31.31	20,039	5.14
1536	Yellow-gray silt loam over gravel	13.85	8,864	2.27
1534.4	Yellow-gray silt loam on gravel	5.88	3,763	.96
1567	Yellow-gray sandy loam over gravel	1.37	877	.22
1564.4	Yellow-gray sandy loam on gravel	4.21	2,694	.69
1528	Brown-gray silt loam on tight clay	.03	19	.004
1590	Gravelly loam	1.00	640	.16
		120.47	77,100	19.75
	(d) Late Swamp and Bottom-Land Soils (1400)			
1450	Black mixed loam	104.45	66,848	17.14
1450.2	Black mixed loam on sand	6.48	4,147	1.06
1401	Deep peat	36.74	23,514	6.03
1402.2	Medium peat on sand	.78	499	.13
1454	Mixed loam	2.69	1,722	.44
		151.14	96,730	24.80
	(e) Miscellaneous			
	Water	4.21	2,694	.69
	Gravel pits	.77	493	.13
		4.98	3,187	.82
	Total area	609.52	390,093	100.00

The upland prairie soils include some areas of recent timber growth where certain kinds of trees have spread over the prairie, but this forestation has not been of sufficient duration to produce the characteristic timber soils. These areas of greater or less width are found along the border of most timber tracts, so that the timber actually extends a little farther than the soil type would indicate.

(b) Upland Timber Soils.—These include a large part of the upland that was formerly covered with forests. These soils contain much less organic matter than the prairie soils because the large roots of dead trees added but little, and the surface accumulations of leaves, twigs, and fallen trees were burned by forest fires or suffered almost complete decay. The timber lands are divided chiefly into two classes—the undulating and the hilly areas.

(c) Terrace Soils.—These include outwash sand and gravel plains, bench lands or second bottom lands, formed by deposition from overloaded streams during the melting of the glacier and subsequent to that time. Finer deposits which were later made upon the coarse, gravelly material now constitute the soil.

(d) Late Swamp and Bottom-Land Soils.—These include the overflow lands, or flood plains of streams, and the very poorly drained lowlands where peats, peaty loams, and mucks have been formed. The organic matter of these soils is derived largely from swamp mosses with grasses as a secondary source.

(e) Miscellaneous.—This includes the area occupied by water, rock outcrops, and gravel pits.

Table 1 shows the area of each type of soil in McHenry county in square miles and in acres, and its percentage of the total area. The accompanying map shows the location and boundary lines of the various types, even down to areas of a few acres.

For explanations concerning the classification of soils and the interpretation of the map and tables the reader is referred to the first part of the Appendix to this report.

INVOICE OF PLANT FOOD IN McHENRY COUNTY SOILS

SOIL ANALYSIS

The composition reported in the accompanying tables is, for the more extensive types, the average of several analyses. These analyses, like most things in nature, show more or less variation, but for general purposes the averages may be considered sufficient to characterize the soil type.

The chemical analysis of a soil by the methods here employed gives the invoice of the total stock of the several plant-food materials actually present in the soil strata sampled and analyzed, but it should be understood that the rate of liberation, as explained in the Appendix, page 27, is governed by many factors.

THE SURFACE SOIL

In Table 2 are reported the amount of organic carbon, which is a measure of the organic matter, and the total quantities of nitrogen, phosphorus, sulfur, potassium, magnesium, and calcium contained in 2 million pounds of the surface soil (the plowed soil of an acre about 6⅔ inches deep) of each type in McHenry

county. Because of the inadequacy of information furnished by mere averages with respect to limestone content and soil acidity, these figures are not included in the tabulated results. For a more complete explanation of this point see note in the tables.

The variation among the different types of soil with respect to the content of important plant-food elements is very marked. For example, the deep peat contains, in the plowed soil of an acre, nearly 30 times as much nitrogen as does the yellow-gray sandy loam. Comparing the deep peat with the most common type in the county, we find about 18 times as much nitrogen in the deep peat as in the yellow-gray silt loam, while on the other hand the yellow-gray silt loam contains about 18 times as much potassium as is found in the deep peat. The supply of phosphorus in the surface soil varies from 580 pounds per acre in the yellow-gray sandy loam to 3,380 pounds in the mixed loam. A sulfur content of 5,500 pounds per acre is found in the deep peat, while in the yellow-gray sandy loam there are but 230 pounds of this element. The magnesium varies in the different types from 1,750 pounds to 20,320 pounds, and the calcium content ranges from 3,270 pounds to 70,780 pounds per acre.

It is important to note that some of the plant-food elements are present in very limited quantities as compared with crop requirements. Some simple computations are of interest in this connection. Assume, for example, that a four-field crop rotation of wheat, corn, oats, and clover yields 50 bushels of wheat per acre, 100 bushels of corn, 100 bushels of oats, and 4 tons of clover hay. It will be found that the most prevalent upland soil of McHenry county, the yellow-gray silt loam, does not contain enough total nitrogen in the plowed soil for the production of such yields to supply four rotations. With respect to phosphorus the condition differs only in degree, this soil containing no more of that essential element than would be required for ten crop rotations yielding at the rates suggested above. On the other hand the amount of potassium in the surface layer of this common soil type would be sufficient for more than 25 centuries if only the grain were sold, or for more than 400 years if the total crops should be removed from the land and nothing returned.

These general statements relating to the total quantities of these plant-food materials in the plowed soil of the most prevalent type in the county certainly emphasize the fact that the supplies of some of these necessary elements of fertility are extremely limited when measured by the needs of large crop yields for even one or two generations of people.

THE SUBSURFACE AND SUBSOIL

In Tables 3 and 4 are recorded the amounts of plant food in the subsurface and subsoil of the different types of soil in McHenry county. It should be remembered, however, that these supplies are of little value unless the top soil is kept rich. These tables also show great stores of potassium and only limited amounts of nitrogen and phosphorus, in agreement with the data for the corresponding surface samples.

TABLE 2.—PLANT FOOD IN THE SOILS OF McHENRY COUNTY, ILLINOIS: SURFACE SOIL
Average pounds per acre in 2 million pounds of surface soil (about 0–6⅔ inches)

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium	Limestone and soil acidity
	(a) Upland Prairie Soils (700, 1000, 1200)								
–26	Brown silt loam	49 570	4 500	1 190	730	35 760	5 670	8 700	
–60	Brown sandy loam	38 050	3 380	970	640	30 140	4 990	6 800	
–90	Gravelly loam	64 040	5 820	1 860	1 020	25 700	20 320	27 300	
	(b) Upland Timber Soils (700, 1000, 1200)								
–34	Yellow-gray silt loam	21 280	1 990	750	460	34 160	3 030	6 140	
–35	Yellow silt loam	25 140	1 940	760	240	28 720	7 360	12 020	
–64	Yellow-gray sandy loam	13 890	1 210	580	230	28 970	2 010	4 580	
–65	Yellow sandy loam	28 480	1 980	840	320	30 480	5 420	14 320	
	(c) Terrace Soils (1500)								
–27	Brown silt loam over gravel	60 650	5 210	1 430	890	34 950	6 030	7 920	
–26.4	Brown silt loam on gravel	52 080	4 600	1 290	790	31 190	6 080	8 700	
–25	Black silt loam	130 190	12 740	2 600	1 850	28 650	13 390	66 760	
–66	Brown sandy loam over gravel	33 460	2 850	1 040	590	25 230	3 350	3 270	
–60.4	Brown sandy loam on gravel	34 620	2 830	1 050	610	25 380	1 750	4 870	
–36	Yellow-gray silt loam over gravel	28 400	2 850	1 170	510	36 630	3 230	6 650	
–34.4	Yellow-gray silt loam on gravel	26 460	2 300	840	340	33 900	3 820	4 720	
–67	Yellow-gray sandy loam over gravel	22 160	1 980	760	320	32 800	3 600	6 560	
–64.4	Yellow-gray sandy loam on gravel	20 640	1 700	840	300	29 160	1 960	5 760	
–28	Brown-gray silt loam on tight clay	74 380	7 180	1 420	1 020	35 680	2 860	7 140	
–90	Gravelly loam	61 420	6 000	1 800	1 400	25 840	8 880	60 860	
	(d) Late Swamp and Bottom-Land Soils (1400)								
–50	Black mixed loam	132 380	12 150	2 430	2 070	24 640	8 590	53 740	
–50.2	Black mixed loam on sand	75 460	6 840	1 160	1 240	21 840	2 780	24 260	
–01	Deep peat[1]	235 710	35 990	1 830	5 500	1 820	3 810	26 950	
–02.2	Medium peat on sand[1]	278 560	24 040	1 190	5 030	6 930	3 830	41 520	
–54	Mixed loam	160 900	16 000	3 380	2 680	23 840	10 680	70 780	

[1]Amounts reported are for 1 million pounds of deep peat and medium peat.

In connection with these tabulated data it should be explained that the figures on limestone content and soil acidity are omitted not because of any lack of importance of these factors, but rather because of the peculiar difficulty of presenting in general averages adequate information concerning the limestone requirement. The limestone requirement for soils is extremely variable. It may vary from farm to farm, and even from field to field. Therefore no attempt is made to include in these tables figures purporting to represent for the various types the limestone content or the soil acidity present. The need for limestone should be determined on every farm and for each field individually. Fortunately this can be easily done by the simple tests described in the Appendix to this report, page 29.

TABLE 3.—PLANT FOOD IN THE SOILS OF MCHENRY COUNTY, ILLINOIS: SUBSURFACE SOIL
Average pounds per acre in 4 million pounds of subsurface soil (about 6⅔–20 inches)

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium	Limestone and soil acidity
	(a) Upland Prairie Soils (700, 1000, 1200)								
-26	Brown silt loam	50 580	4 790	1 850	780	74 380	15 370	17 690	
-60	Brown sandy loam	44 040	3 840	1 640	1 080	70 060	16 080	64 600	
	(b) Upland Timber Soils (700, 1000, 1200)								
-34	Yellow-gray silt loam	17 900	1 940	1 610	580	73 460	11 220	15 680	
-35	Yellow silt loam	26 760	2 160	1 400	400	60 680	16 800	41 680	
-64	Yellow-gray sandy loam	17 930	1 600	1 350	350	61 280	8 930	13 200	
-65	Yellow sandy loam	21 280	1 560	1 600	240	62 160	21 240	48 280	
	(c) Terrace Soils (1500)								
-27	Brown silt loam over gravel	52 460	4 970	1 980	960	73 830	8 340	15 200	
-26.4	Brown silt loam on gravel	59 800	5 320	2 230	1 170	65 280	10 730	14 040	
-25	Black silt loam	80 680	7 680	3 140	1 520	68 440	26 960	62 000	
-66	Brown sandy loam over gravel	43 400	4 060	1 660	1 000	49 380	4 080	5 800	
-60.4	Brown sandy loam on gravel	41 880	3 450	1 880	890	48 310	6 120	9 050	
-36	Yellow-gray silt loam over gravel	18 500	2 280	2 300	440	75 260	11 060	11 660	
-34.4	Yellow-gray silt loam on gravel	20 640	2 240	1 640	400	68 880	9 360	13 040	
-67	Yellow-gray sandy loam over gravel	18 960	2 160	1 440	200	72 080	10 600	10 080	
-64.4	Yellow-gray sandy loam on gravel	20 320	1 960	1 520	600	60 160	6 680	8 880	
-28	Brown-gray silt loam on tight clay	31 200	2 840	1 120	1 000	78 200	7 720	13 760	
	(d) Late Swamp and Bottom-Land Soils (1400)								
-50	Black mixed loam	136 700	11 590	4 000	2 250	60 140	15 160	48 120	
-50.2	Black mixed loam on sand	16 400	1 080	840	40	48 760	3 560	9 280	
-01	Deep peat[1]	943 430	68 470	2 230	10 550	2 400	7 720	53 930	
-02.2	Medium peat on sand.[1]	553 360	40 200	1 960	8 540	14 300	4 920	63 020	
-54	Mixed loam	164 720	16 040	5 360	2 840	43 960	19 680	209 480	

[1]Amounts reported are for 2 million pounds of deep peat and medium peat.

In connection with these tabulated data it should be explained that the figures on limestone content and soil acidity are omitted not because of any lack of importance of these factors, but rather because of the peculiar difficulty of presenting in general averages adequate information concerning the limestone requirement. The limestone requirement for soils is extremely variable. It may vary from farm to farm, and even from field to field. Therefore no attempt is made to include in these tables figures purporting to represent for the various types the limestone content or the soil acidity present. The need for limestone should be determined on every farm and for each field individually. Fortunately this can be easily done by the simple tests described in the Appendix to this report, page 29.

TABLE 4.—PLANT FOOD IN THE SOILS OF McHENRY COUNTY, ILLINOIS: SUBSOIL
Average pounds per acre in 6 million pounds of subsoil (about 20-40 inches)

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium	Limestone and soil acidity
	(a) Upland Prairie Soils (700, 1000, 1200)								
-26	Brown silt loam	29 170	3 040	2 530	900	104 000	52 560	86 010	
-60	Brown sandy loam	25 680	2 790	2 130	900	118 620	73 380	175 020	
	(b) Upland Timber Soils (700, 1000, 1200)								
-34	Yellow-gray silt loam	15 930	1 930	2 830	720	110 180	24 710	63 930	
-64	Yellow-gray sandy loam	13 760	1 560	2 300	280	97 360	24 640	35 580	
-65	Yellow sandy loam	24 600	1 380	2 700	300	96 060	46 380	208 740	
	(c) Terrace Soils (1500)								
-27	Brown silt loam over gravel	27 590	3 140	2 850	800	103 730	33 560	32 630	
-26.4	Brown silt loam on gravel	29 580	2 900	2 520	500	84 180	20 140	20 700	
-25	Black silt loam	18 720	1 980	3 120	600	103 620	104 160	294 870	
-66	Brown sandy loam over gravel	28 200	2 610	2 220	900	78 300	8 220	19 170	
-60.4	Brown sandy loam on gravel	22 820	2 080	2 340	720	69 740	12 020	39 500	
-36	Yellow-gray silt loam over gravel	15 180	2 190	3 810	270	107 820	19 530	20 610	
-34.4	Yellow-gray silt loam on gravel	15 060	1 620	2 520	240	84 060	18 360	22 800	
-67	Yellow-gray sandy loam over gravel	19 980	2 040	2 640	540	127 800	54 720	139 020	
-64.4	Yellow-gray sandy loam on gravel	16 620	2 160	2 460	540	84 780	12 600	28 440	
-28	Brown-gray silt loam on tight clay	35 880	3 420	1 380	660	125 160	11 640	17 100	
	(d) Late Swamp and Bottom-Land Soils (1400)								
-50	Black mixed loam	55 010	4 460	4 490	2 000	94 880	19 930	105 180	
-50.2	Black mixed loam on sand	10 380	360	1 500	0	74 760	6 060	26 760	
-01	Deep peat[1]	1 395 230	65 880	2 310	19 260	7 590	9 170	70 320	
-02.2	Medium peat on sand	40 560	2 640	1 500	1 380	78 840	47 460	386 160	
-54	Mixed loam	85 560	6 960	3 660	2 100	62 760	44 040	439 260	

In connection with these tabulated data it should be explained that the figures on limestone content and soil acidity are omitted not because of any lack of importance of these factors, but rather because of the peculiar difficulty of presenting in general averages adequate information concerning the limestone requirement. The limestone requirement for soils is extremely variable. It may vary from farm to farm, and even from field to field. Therefore no attempt is made to include in these tables figures purporting to represent for the various types the limestone content or the soil acidity present. The need for limestone should be determined on every farm and for each field individually. Fortunately this can be easily done by the simple tests described in the Appendix to this report, page 29.

[1]Amounts reported are for 3 million pounds of deep peat.

DESCRIPTION OF INDIVIDUAL SOIL TYPES

(a) UPLAND PRAIRIE SOILS

The upland prairie soils of McHenry county cover an area of 153.05 square miles, or 25.11 percent of the area of the county. They are usually dark in color, owing to their large organic-matter content. The accumulation of organic matter in the prairie soils is due to the growth of prairie grasses that once covered them. The network of roots from these grasses was protected from complete decay by the imperfect aeration resulting from the covering of fine soil material and from the water it contained. On the native prairies the tops of these grasses were usually burned or decayed almost completely, so that the tops added very little organic matter to the soil.

Brown Silt Loam (726, 1026, 1226)

Brown silt loam, covering an area of 120.08 square miles, or 19.7 percent of the total area of the county, is one of the most extensive types in McHenry county. It occupies a considerable part of the less rolling land, some of which needs artificial drainage. The presence of kettle-holes makes complete drainage rather difficult, with the result that many small ponds are found. Small local areas of yellow-gray silt loam, sandy loam, gravelly loam, black mixed loam, and peat, too small to be shown on the map, are included in the type.

The surface soil, 0 to 6⅔ inches, is a brown silt loam, varying from yellowish brown on the more rolling areas to dark brown or black on the more nearly level and poorly drained tracts. In physical composition it varies to some extent but normally contains from 50 to 70 percent of the different grades of silt. In the low areas the proportion of clay is usually higher than on the more rolling parts, where a perceptible amount of sand may occur. The organic-matter content is somewhat variable but averages approximately 4.2 percent, or 42 tons per acre. The content is lower on the more rolling areas and higher on the more level parts. Where considerable erosion has occurred on the steep slopes of moraines, the type is mapped as yellow-gray silt loam although timber may never have grown there.

The natural subsurface is represented by a stratum varying from 6 to 20 inches in thickness. This variation is due to differences in topography and to erosion, the stratum being thinner on the more rolling areas. Less organic matter has accumulated on these areas than on the more level tracts and it disappears more rapidly with depth. In physical composition the subsurface varies in the same manner as the surface, but normally contains a slightly larger amount of clay and a smaller amount of organic matter. The organic-matter content of the stratum sampled (6⅔ to 20 inches) averages about 2.2 percent, varying from 1.8 to 2.8 percent. In color the subsurface varies from dark brown to light yellowish brown, becoming lighter with depth.

The natural subsoil begins at a depth of 12 to 20 inches and extends to an indefinite depth, but for analysis it is sampled to a depth of 40 inches. It varies from a yellow to a drabbish yellow clayey material usually made up of glacial drift. In some of the flat areas, however, where material has washed in from the surrounding parts, the drift is not reached at a depth of 40 inches. In some

places the stratum of glacial gravel beneath the loessial material is very evident and interferes in the collecting of samples.

Treatment.—Altho brown silt loam is fairly well supplied with organic matter, continuous cropping and the removal of practically all the crop residues will gradually reduce the amount until this, with its nitrogen, becomes the limiting factor in crop yields. On many farms or on parts of farms, this condition has already been reached.

In the management of this type, it is essential that manure or crop residues, including legumes, should be returned to the soil in the most practical and advantageous way. No form of organic matter should be burned. In live-stock farming the manure should be applied to the soil as soon as possible after it is produced, in order to avoid loss. Limestone and phosphorus should usually be applied to soil of this type. For results secured in field experiments on brown silt loam, see page 38 of the Supplement.

Brown Sandy Loam (960, 1060)

Brown sandy loam occurs principally in the southern part of the county and covers an area of 28.24 square miles, or 4.63 percent of the total area of the county. The sand of the type is derived very largely from glacial material. The type varies in topography from almost flat to decidedly rolling.

The surface soil, 0 to 6⅔ inches, consists of a brown sandy loam varying in color from a light or yellowish brown to a dark brown or even to a black. The sand content varies, being most abundant in the small patches that have been produced largely by the action of the wind. The organic-matter content is about 3 percent, or 30 tons per acre.

The subsurface, 6⅔ to 18 or 20 inches, consists of a brown to a yellowish brown sandy loam varying in the same manner as the surface soil. The organic-matter content is about 1.9 percent, or 38 tons per acre.

The subsoil is variable, in some places being made up of boulder clay while in others it is a yellowish sand, a clayey sand, or a sandy clay.

Treatment.—In general the type is sufficiently rolling for good drainage. It requires for its improvement the large use of organic matter, applied both as manure and as crop residues. This soil, being loose and better aerated than brown silt loam, suffers greater loss of organic matter by oxidation; hence greater difficulty is experienced in maintaining the necessary supply. Crop residues, legume crops, and manure must constitute the chief materials by which the organic matter is maintained. Ground limestone should usually be applied at the rate of about 2 or 3 tons per acre. These applications should be made frequently enough to keep a supply in the soil, but need not be made oftener than every four or five years. Sometimes the subsurface is well stocked with limestone in which case the supply will be easy to maintain.

Gravelly Loam (790, 1090)

Gravelly loam usually occurs in small areas and is fairly well distributed over the county, altho none is found in the Iowan glaciation. The type covers

an area of 3,027 acres. It is of very little importance from an agricultural standpoint, being adapted only for a low grade of pasture land.

(b) UPLAND TIMBER SOILS

The upland timber soils are deficient in organic matter owing to the fact that in forests the vegetable material from trees accumulates upon the surface and is either burned or suffers almost complete decay. Grasses, which furnish large amounts of humus-forming roots, do not grow to any extent. Moreover, the organic matter that had accumulated before the timber began growing is removed thru various decomposition processes, with the result that in these soils generally the nitrogen and organic-matter contents have become too low for the best growth of farm crops. The total area of upland timber soils in the county is 179.88 square miles, or 29.52 percent of the area of the county.

Yellow-Gray Silt Loam (734, 1034, 1234)

Yellow-gray silt loam is the most extensive soil type in McHenry county, covering an area of 130.04 square miles, or 21.34 percent of the total area of the county. While this type is confined chiefly to the more rolling parts of the moraines, it is also found irregularly distributed over other parts of the county.

The surface soil, 0 to 6⅔ inches, is a gray or yellowish gray silt loam, incoherent and mealy, but not granular. It varies greatly in physical composition, owing to the fact that in many places the thin covering of loess has been removed by erosion and a variable drift exposed. There are many local areas of sand or gravelly loam, but they are too small to be shown on the map. Likewise, there are many small areas of black mixed loam or black silt loam too small to be indicated on the map, that are found in kettle-hole depressions. The amount of organic matter in the surface stratum varies from 1.3 to 2.1 percent, with an average of about 1.8 percent, or 18 tons per acre. In some places erosion has reduced the content of organic matter much below the point of productiveness, and many small areas are decidedly yellow in color. On many of the steeper slopes much gravel and even small boulders are found.

The natural subsurface varies from 3 to 10 inches in thickness, being thinner on the more rolling areas. In color it is gray, grayish yellow, or yellow. It is somewhat pulverulent, but becomes more coherent and plastic with depth. The organic-matter content is about .8 percent, or 16 tons per acre in four million pounds of soil.

The subsoil is usually a yellow to a grayish yellow boulder clay. On the more level areas, however, the boulder clay may not be reached within 40 inches of the surface. The deeper subsoil frequently contains large amounts of limestone, as shown by the brisk effervescence when the hydrochloric acid test is applied.

Treatment.—In the management of yellow-gray silt loam, one of the essential points is the maintenance or increase of organic matter. This is even more necessary with this type than with brown silt loam, because this soil is naturally much more deficient in that constituent. The organic matter tends to prevent "running together," and on some of the more rolling areas lessens the washing. It gives better tilth to the soil under all conditions. As it decays, it supplies nitrogen and tends to liberate other plant food, as explained in the Appendix.

For adding organic matter to the soil the extensive use of the clovers, alfalfa, or other legumes is advised. These should be returned either directly to the soil along with crop residues, or in the manure produced in their consumption.

Because of the fact that in this type of soil in McHenry county carbonates are usually found in abundance in the subsoil and are sometimes present in the subsurface, it is difficult to prescribe a definite recommendation for the application of limestone that will apply to all locations. However, for the thrifty growth of such legumes as sweet clover and alfalfa limestone should be present in the surface soil in order to give the young plants a vigorous start. Therefore a moderate application of limestone, say 2 tons per acre, ought to prove profitable on all land of this type, and in some situations perhaps more than this amount could be applied to advantage, depending upon the depth to the naturally existing limestone.

Ultimately, for the best results in crop production the phosphorus content will need to be increased.

For results from practical field experiments on yellow-gray silt loam, see page 46 of the Supplement.

Yellow Silt Loam (735, 1035)

Yellow silt loam occurs principally along the Fox river in Town 43 North, Range 8 East, and in the northeast part of Town 44 North, Range 7 East. The type covers 3,149 acres, or less than one percent of the area of the county.

The surface soil, 0 to 6⅔ inches, is a yellow or yellowish gray silt loam, which usually contains some sand or gravel. This stratum is frequently formed from glacial drift, the loess having been removed by erosion. Owing to its derivation it varies a great deal in physical composition. The organic-matter content is about 2.3 percent, or 23 tons per acre.

The natural subsurface varies from 3 to 10 inches in thickness and is composed chiefly of a yellow or yellowish gray silt loam, but may vary from this to boulder clay and even to a very gravelly form of boulder clay. The organic-matter content of the stratum sampled (6⅔ to 20 inches) is about .9 percent.

The subsoil is made up of boulder clay, with about .4 percent of organic matter.

Treatment.—One of the best uses to which this type can be put is permanent pasture. As a rule, it cannot be satisfactorily cropped in ordinary rotations but it may be used very successfully for long rotations with pasture or meadow much of the time. Where limestone is naturally lacking in the upper portion of the soil, this material may well be used for the legumes in the rotation, or even as a top dressing to encourage their growth in pastures. Where this type has been long cultivated and thus exposed to surface washing, it is particularly deficient in nitrogen. Indeed, on such land the low supply of nitrogen is the factor that first menaces the growth of grain crops. Nitrogen is to be obtained from the air thru the growth of leguminous crops.

Yellow-Gray Sandy Loam (764, 1064)

Yellow-gray sandy loam occurs in many irregular areas all over the county. The total area covered by this type is 43.82 square miles, or 7.19 percent of

the area of the county. Its topography is about the same as that of the yellow-gray silt loam, and it occurs on morainal areas somewhat similar to that type.

The surface soil, 0 to 6⅔ inches, is a gray or yellowish gray sandy loam, varying rather widely in its physical composition. In some localities it contains a considerable percentage of gravel, sufficient in many cases to form a gravelly loam, but the areas are too small to be shown on the map. The organic-matter content is approximately 1.2 percent, or 12 tons per acre.

The natural subsurface is represented by a stratum from 4 to 10 inches in thickness. It varies in physical composition the same as the surface, except that it contains more gravel. It is frequently formed from the glacial drift. The stratum sampled (6⅔ to 20 inches) contains about .8 percent of organic matter.

The subsoil is made up of glacial drift and contains about .4 percent of organic matter. The surface and subsurface are usually acid, altho the subsoil sometimes contains a considerable amount of limestone.

Treatment.—Where clover continues to fail on this type, applications of 2 tons of ground limestone can well be made for the purpose of increasing the growth of legumes. The content of organic matter and of nitrogen must be largely increased, since this type is one of the lowest in organic matter found in the county. The phosphorus content is very low and should therefore be built up in order to obtain the best results. Sweet clover is an excellent crop to grow on this type because of the large amount of organic matter that it supplies.

Yellow Sandy Loam (1065)

Yellow sandy loam occurs in the very rolling and sandy area of the county. It occupies 704 acres.

The surface soil, 0 to 6⅔ inches, is in the main a yellow sandy loam altho it varies considerably in physical composition, in places containing some gravel. The type contains a larger amount of organic matter than does the yellow-gray sandy loam because of the fact that it has never been under cultivation. The organic-matter content is 2.4 percent, or twice the amount present in the preceding type.

The subsurface also varies in physical composition, being rather gravelly in some places.

The subsoil corresponds in physical composition to the surface and subsurface.

Treatment.—This type is adapted only to pasture, and legumes should be grown on it. Sweet clover is probably one of the best plants for the purpose. Limestone is likely to be beneficial.

(c) TERRACE SOILS

Terrace soils usually occur along streams. They were formed at a time when the streams, owing to melting glacier ice, were much larger than they are at present, and carried large amounts of coarse material, such as sand and gravel. Upon any decrease in their velocity, these overloaded streams deposited debris along their courses. This resulted in the partial filling of the valley and the formation of what are now the terraces, bench lands, or second bottom lands.

Finer material later deposited over this sand and gravel forms the present soil. When the streams became reduced to their normal size after the glacier had melted, they began cutting down thru this deposit, and the beds of the streams are now so low that the terraces, or benches, do not overflow.

Several gravel outwash plains occur which were formed by the sand and gravel that was deposited when water from the melting ice spread over large level areas. These plains were later covered by the finer material which forms the present soil.

Brown Silt Loam over Gravel (1527)

Brown silt loam over gravel occurs in four large areas in the county, one near Hebron, one near Harvard, one north of Franklinville, and the other just west of Rush creek. The type covers 45.93 square miles, or 7.54 percent of the area of the county.

The surface soil, 0 to 6⅔ inches, varies from a brown to a very dark brown silt loam which frequently contains some sand, altho not enough to cause it to be classified as a sandy loam. While the topography is usually flat, some slight undulations occur which were probably produced by the channels of the flooded streams. The surface soil contains about 5 percent of organic matter, or 50 tons per acre. It varies from 4 to 6.5 percent.

The natural subsurface stratum varies from 7 to 16 inches in thickness. The organic-matter content of the stratum as sampled (6⅔ to 20 inches) is about 2.3 percent, or 46 tons per acre. In physical composition it is about the same as the surface.

The subsoil is a yellow to a mottled yellow silt loam with some gravel appearing in the deeper subsoil. The depth to gravel, however, varies from 36 to 54 inches or more.

Treatment.—All strata are pervious to water, so that drainage is very good, provided a sufficient outlet is obtained. The gravel is so far from the surface that crops do well even in years of some drouth. This is one of the best of the terrace types. In the improvement of this type, limestone, phosphorus, and organic matter should be provided as recommended for the brown silt loam of the upland (see page 11).

Brown Silt Loam on Gravel (1526.4)

Brown silt loam on gravel represents a type in which the fine soil material is less than 30 inches in thickness, or in which the gravel is within 30 inches of the surface. The principal areas are found in the broad valleys of Rush creek and the north branch of the Kishwaukee. The total area is 4,358 acres, or 1.12 percent of the area of the county.

The surface soil, 0 to 6⅔ inches, is a brown silt loam containing some sand. Organic matter is present to the amount of about 4.8 percent, or 48 tons per acre.

The natural subsurface stratum varies from 8 to 12 inches in thickness, and is a brown to light yellowish brown silt loam containing gravel which in some cases amounts to as much as 5 percent. The organic-matter content of the stratum sampled (6⅔ to 20 inches) is about 2.6 percent, or 52 tons in four million pounds of soil.

The subsoil is about the same as the subsurface until gravel is reached. The gravel consists of a mixture of fine gravel and sand with some of the finer soil constituents.

Treatment.—This soil type is well drained, but because of the nearness of gravel to the surface it does not resist drouth well. For this reason early maturing crops are desirable. In the management of the type care must be taken to maintain the supply of organic matter, since this constituent is so important in the conservation of moisture. An application of 2 or 3 tons per acre of limestone is recommended in order that clover or alfalfa may be grown.

Black Silt Loam (1525)

Black silt loam occurs in the lower and more poorly drained parts of the terrace. Either the gravel is so deep or the outlet is so poor that drainage does not take place readily. The type covers an area of 1,069 acres.

The surface soil, 0 to 6⅔ inches, is a black silt loam becoming in some cases so heavy as to form a black clayey silt loam. It contains about 10.5 percent of organic matter, or 105 tons per acre.

The natural subsurface soil is a black clayey silt loam and extends to a depth of 18 to 20 inches. The stratum sampled (6⅔ to 20 inches) contains approximately 2.8 percent of organic matter.

The subsoil is represented by a clayey stratum varying in color from a pale yellow to a drabbish yellow. It contains about .5 percent of organic matter.

Treatment.—All strata are pervious to water so that drainage is effected very readily when proper tiling is done. In the management of this type about the only consideration at present is the maintenance of good physical condition by means of active organic matter. Usually a good supply of phosphorus and limestone is present.

Brown Sandy Loam over Gravel (1566)

Brown sandy loam over gravel is found principally in the south third of the county. It covers an area of 8.41 square miles or 5,382 acres. The topography is flat to slightly undulating.

The surface soil, 0 to 6⅔ inches, is a brown sandy loam with about 2.9 percent of organic matter, or 29 tons per acre.

The subsurface is a brown sandy loam containing about 1.9 percent of organic matter. In physical composition it is practically the same as the surface soil, but it becomes yellow at about 16 to 18 inches.

The subsoil is a yellow sandy silt which in some cases becomes gravelly at 36 inches.

Treatment.—The very low nitrogen content, which is characteristic of a sandy soil, calls for the liberal use of legume crops; and the chemical analysis indicates the need of limestone in order to insure a thrifty growth of the legumes. An application of about 2 tons per acre of ground limestone is suggested. The phosphorus content is also low and doubtless as times goes on, under a system that produces larger crops, phosphorus will become a limiting element that will need to be replenished.

Brown Sandy Loam on Gravel (1560.4)

Brown sandy loam on gravel occurs very largely in the southern part of the county in the vicinity of Marengo. Another large area occurs south of Crystal Lake. The type covers an area of 31.31 square miles, or 5.14 percent of the area of the county. The topography is flat.

The surface soil, 0 to 6⅔ inches, is a brown sandy loam varying in sand content and containing from 2 to 3 percent of gravel. The organic-matter content averages 2.5 percent.

The subsurface stratum contains about 1.7 percent of organic matter and a noticeable amount of gravel.

The gravel subsoil begins at a depth of 16 to 28 inches and consists of a mixture of coarse sand and fine gravel. Comparatively small amounts of the finer soil constituents are present in this gravel. The nearness of gravel to the surface reduces the moisture-holding capacity of this type, with the result that crops may suffer from drouth.

Treatment.—The type is sometimes acid in the upper strata but occasionally the subsoil contains a considerable amount of limestone. In the management of this soil the same recommendations apply as those given in the discussion of the preceding type.

Yellow-Gray Silt Loam over Gravel (1536)

Yellow-gray silt loam over gravel is found in various parts of the county but more particularly along the lower Fox river, in the Iowan glaciation in the northwest part of the county, and in Towns 45 and 46 North, Range 7 East. The total area is 13.85 square miles.

The surface soil, 0 to 6⅔ inches, is a brownish yellow or grayish yellow silt loam, verging toward yellow sandy loam in some localities. The organic-matter content averages 2.4 percent, or 24 tons per acre.

The natural subsurface is a stratum of a yellowish or grayish yellow color. It varies from 8 to 10 inches in thickness. The organic-matter content of the stratum sampled (6⅔ to 20 inches) is about .8 percent.

The subsoil is a yellow silt to clayey silt.

Treatment.—The nitrogen in this soil is very low, and methods looking toward its replenishment should be adopted at once. Applications of limestone amounting to 2 or 3 tons per acre should be made, and this material will probably need to be replenished every four or five years in order to encourage the growth of legumes. The organic-matter content should be maintained by turning under crop residues and all forms of available organic material. The phosphorus supply also is insufficient and in the course of time, if not immediately, this element should be applied.

Yellow-Gray Silt Loam on Gravel (1534.4)

Yellow-gray silt loam on gravel is found widely distributed thruout the county, but covers a total area of only 5.88 square miles.

The surface soil, 0 to 6⅔ inches, is a brownish yellow or yellowish gray silt loam containing about 2.3 percent of organic matter.

The subsurface is represented by a stratum from 7 to 10 inches in thickness. The organic-matter content of the stratum sampled (6⅔ to 20 inches) is about .9 percent.

The subsoil is a yellowish clayey silt which in some cases passes into gravel at 30 to 38 inches.

Treatment.—This soil is similar in composition to that of the preceding type. It is low in organic matter, nitrogen, and phosphorus, and limestone is absent. In order to improve it, therefore, an application of 2 or 3 tons of limestone per acre should be made, and legumes should be grown either to be turned back into the soil directly or to be fed to stock and the manure applied. The phosphorus content should be increased by applying from ½ to 1 ton per acre of raw rock phosphate in a four- or five-year rotation.

Yellow-Gray Sandy Loam over Gravel (1567)

Yellow-gray sandy loam over gravel is found principally along the Fox river. It covers an area of 877 acres.

The surface soil, 0 to 6⅔ inches, is a gray to grayish yellow sandy loam with about 1.9 percent of organic matter, or 19 tons per acre.

The natural subsurface consists of a yellow sandy loam varying from 6 to 10 inches in thickness. The organic-matter content of the stratum sampled (6⅔ to 20 inches) is approximately .8 percent.

The subsoil varies from a yellow sandy silt to a yellow sand. The former is much more common than the latter.

Treatment.—The type is rather low in several elements of plant food. Legumes should be grown in order to increase the nitrogen, as the chemical analysis shows the total amount of this element to be less than 2,000 pounds in the plowed soil. The subsoil usually contains a considerable amount of limestone; but since this material is lacking in the surface and subsurface, an application of about 2 tons per acre is recommended. The phosphorus supply is likewise very meagre, and before this becomes a limiting element it should be increased by applications of a half ton or more of raw rock phosphate to the acre every four or five years.

Yellow-Gray Sandy Loam on Gravel (1564.4)

Yellow-gray sandy loam on gravel occurs in various parts of the county, but not in any large areas. It is always mixed more or less with other types. The total area amounts to 2,694 acres.

The surface soil, 0 to 6⅔ inches, is a yellow or grayish yellow sandy loam containing about 1.8 percent of organic matter, or 18 tons per acre.

The natural subsurface soil is represented by a stratum 6 to 10 inches in thickness. The stratum sampled (6⅔ to 20 inches) contains about .9 percent of organic matter.

The subsoil is a yellowish sandy silt which passes into gravel at a depth of 18 to 26 inches.

Treatment.—This soil, as is characteristic of a sandy loam, is very low in nitrogen (less than 2,000 pounds per acre being present in the plowed soil) and organic matter. The stock of phosphorus is likewise decidedly low. In the management of this soil, therefore, legumes should be grown and all available

manure should be applied. Analysis shows no limestone above the subsoil; therefore crushed limestone should be applied at the rate of about 2 tons per acre. Phosphorus may be supplied in the form of finely ground raw rock phosphate at the rate of ½ to 1 ton per acre.

Brown-Gray Silt Loam on Tight Clay (1528)

Only a very small area of brown-gray silt loam on tight clay, 19 acres in extent, occurs in the county.

The surface soil, 0 to 6⅔ inches, is a brown silt loam containing about 6.4 percent of organic matter.

The subsurface is a gray silt loam containing approximately 1.3 percent of organic matter.

The subsoil consists of a tight clay, rather impervious.

Treatment.—According to the analysis, limestone is absent. Therefore this material should be applied at the rate of about 2 tons per acre. The growing of sweet clover is recommended. This may serve to some extent to break up the clay of the subsoil.

Gravelly Loam (1590)

Gravelly loam does not form an important type agriculturally, covering as it does only one square mile.

The surface soil contains about 5.3 percent of organic matter. The type is of value only for pasture.

(d) LATE SWAMP AND BOTTOM-LAND SOILS

Black Mixed Loam (1450)

Black mixed loam is the most common of the swamp types, and is distributed all over the county. The areas vary in size from those that are several square miles in extent to numberless areas too small to map. The type covers an area of 104.45 square miles, or 17.14 percent of the total area of the county.

The surface soil, 0 to 6⅔ inches, is a black soil varying from a peat on one hand to a clay loam or a black sandy loam on the other. These different types are so small in extent that it is practically impossible to show them on the map. Hence the entire area is mapped as the black mixed loam. The plowed soil contains about 11.4 percent of organic matter, or 114 tons per acre.

The natural subsurface is represented by a stratum 8 to 12 inches in thickness. The stratum sampled (6⅔ to 20 inches) contains about 5.9 percent of organic matter, or 118 tons per acre.

The subsoil is a yellowish drab or drab silty clay or clayey silt which contains about 1.6 percent of organic matter.

Treatment.—All strata are pervious to water, so that artificial drainage may result in transforming this land into very productive soil. It is well supplied with phosphorus and nitrogen. Limestone is often abundant in all strata but sometimes it may be totally absent. In such exceptional cases the artificial application of this material should be made. This land is used principally for pasture because of the fact that it has not yet been sufficiently drained for cropping.

Black Mixed Loam on Sand (1450.2)

Black mixed loam on sand occurs in the vicinity of Marengo and extends into Boone county to the west. It covers an area of 6.48 square miles.

The surface soil, 0 to 6⅔ inches, varies from a loam to a sandy loam. It contains about 6.5 percent of organic matter.

The subsurface is a black to grayish sand with about .7 percent of organic matter.

The subsoil is a gray or yellow sand.

Treatment.—Provision for drainage, which is the first requirement of this land, has already been made in the principal tract of this type. Cropping, however, has been pretty largely attended by failure. This kind of soil is not constituted to endure drouth, and successful cropping will therefore depend much upon the time of maturity of crops grown, the distribution of rainfall, and the height of the water table. Early maturing crops, such as winter wheat and rye, provided conditions at time of seeding in the autumn are sufficiently favorable to insure germination, are much more likely to succeed than a crop like corn.

A definite prescription for the application of fertilizing materials is scarcely warrantable at this time because this type of soil is so peculiar that reliable information must be based very largely upon actual experience.

Deep Peat (1401)

Deep peat is distributed thruout the county and covers 36.74 square miles, or 6.03 percent of the total area of the county.

The surface soil, 0 to 6⅔ inches, is a black peat containing about 75 percent of organic matter, or 375 tons per acre.

The subsurface soil contains about 81 percent of organic matter.

The subsoil contains about 80 percent of organic matter.

Treatment.—Drainage is the first requirement of this type. This in many cases is rather difficult to secure because tiles cannot be laid to good advantage in peat on account of irregular settling and the consequent displacement of the line. This difficulty may be partly overcome by placing the tiles upon boards laid in the bottom of the ditch, altho such a system cannot be regarded as permanent.

Where thoro drainage can be provided, either by the above method or by open ditches, very marked improvement can be made in the productive power of peat by the liberal use of potassium, which is by far the most deficient element. Farm manure and crop residues contain sufficient potassium to make their use very effective on deep peat soil; and with commercial potash salts at prohibitive prices, farm manure, corn stalks, straw, etc., must be utilized for the improvement of such soils.

The chemical analysis shows that limestone is not always present in the deep peat of McHenry county. When the simple tests described in the Appendix, page 29, indicate the absence of limestone, then this material should be applied at the rate of about 2 tons per acre.

For an account of field experiments on deep peat the reader is referred to page 49 of the Supplement.

PLATE 9.—HUMMOCKS ON "BOG" LAND CHARACTERISTIC OF PEAT AND CERTAIN OTHER SWAMPY SOILS AFTER PASTURING

Medium Peat on Sand (1402.2)

Medium peat on sand occurs in low swampy places similar to those occupied by deep peat, but the conditions for the formation of this type have not been so favorable as for deep peat, and as a consequence the peaty material is less than 30 inches thick. The type covers 499 acres.

The surface soil, 0 to 6⅔ inches, contains about 48 percent of organic matter.

The subsurface is of about the same general character as the surface stratum.

The subsoil consists largely of sand, with only 1.2 percent of organic matter.

Treatment.—The type needs drainage and the application of potassium.

Mixed Loam (1454)

Mixed loam occurs as bottom land in different parts of the county, but usually in small areas. There are 1,722 acres of this type in the county.

The surface soil, 0 to 6⅔ inches, contains about 13.9 percent of organic matter and consists of a black mixed loam, the variability of which is produced by depositions during overflow.

The subsurface contains about 7.1 percent of organic matter.

The subsoil contains about 2.5 percent of organic matter.

The type is rich in nitrogen and phosphorus and in the area sampled has an abundance of limestone.

APPENDIX

EXPLANATIONS FOR INTERPRETING THE SOIL SURVEY

CLASSIFICATION OF SOILS

In order to intelligently interpret the soil maps, the reader must understand something of the method of soil classification upon which the survey is based. Without going far into details the following paragraphs are intended to furnish a brief explanation of the general plan of classification here used.

The unit in the soil survey is the soil type, and each type possesses more or less definite characteristics. The line of separation between adjoining types is usually distinct, altho sometimes one type grades into another so gradually that it is very difficult to draw the line between them. In such exceptional cases, some slight variation in the location of soil-type boundaries is unavoidable.

In establishing soil types several factors must be taken into account. These are: (1) the geological origin of the soil, whether residual, cumulose, glacial, eolial, alluvial, or colluvial; (2) the topography, or lay of the land; (3) the native vegetation, as forest or prairie grasses; (4) the depth and the character of the surface, the subsurface, and the subsoil, as to the percentages of gravel, sand, silt, clay, and organic matter which they contain, their porosity, granulation, friability, plasticity, color, etc.; (5) the natural drainage; (6) the agricultural value, based upon its natural productiveness; (7) the ultimate chemical composition and reaction.

Great Soil Areas in Illinois.—On the basis of the first of the above mentioned factors, namely, the geological origin, the state of Illinois has been divided into sixteen great soil areas with respect to their geological formation. The names of these areas are given in the following list along with their corresponding index numbers, the use of which is explained below. For the location of these geological areas, the reader is referred to the general map published in Bulletins 123 and 193.

100 *Unglaciated,* comprizing three areas, the largest being in the south end of the state
200 *Illinoisan moraines,* including the moraines of the Illinoisan glaciation
300 *Lower Illinoisan glaciation,* covering nearly the south third of the state
400 *Middle Illinoisan glaciation,* covering about a dozen counties in the west-central part of the state
500 *Upper Illinoisan glaciation,* covering about fourteen counties northwest of the middle Illinoisan glaciation
600 *Pre-Iowan glaciation,* but now believed to be part of the upper Illinoisan
700 *Iowan glaciation,* lying in the central northern end of the state
800 *Deep loess areas,* including a zone a few miles wide along the Wabash, Illinois, and Mississippi rivers
900 *Early Wisconsin moraines,* including the moraines of the early Wisconsin glaciation
1000 *Late Wisconsin moraines,* including the moraines of the late Wisconsin glaciation
1100 *Early Wisconsin glaciation,* covering the greater part of the northeast quarter of the state
1200 *Late Wisconsin glaciation,* lying in the northeast corner of the state
1300 *Old river bottom and swamp lands,* found in the older or Illinoisan glaciation
1400 *Late river bottom and swamp lands,* those of the Wisconsin and Iowan glaciations
1500 *Terraces,* formed by overloaded streams draining from the glaciers and gravel outwash plains
1600 *Lacustrine deposits,* formed by Lake Chicago or the enlarged Lake Michigan

Mechanical Composition of Soils.—The mechanical composition, or the texture, is a most important feature in characterizing a soil. The texture depends upon the relative proportions of the following physical constituents:

Organic matter: undecomposed and partially decayed vegetable material

Inorganic matter: clay, silt, fine sand, sand, gravel, stones.

Classes of Soils.—Based upon the relative proportion of the various constituents mentioned above, soils may be grouped into a number of well recognized classes. Following is a list of these classes, arranged according to their index numbers, the use of which is explained below.

Index Number Limits	Class Names
0 to 9	Peats
10 to 12	Peaty loams
13 to 14	Mucks
15 to 19	Clays
20 to 24	Clay loams
25 to 49	Silt loams
50 to 59	Loams
60 to 79	Sandy loams
80 to 89	Sands
90 to 94	Gravelly loams
95 to 97	Gravels
98	Stony loams
99	Rock outcrop

Naming and Numbering Soil Types.—The naming of soil types has been the subject of much discussion, and practice varies considerably in this matter. In this soil survey of Illinois a system of classification and naming has been adopted which is based upon the various considerations presented in the preceding paragraphs.

After texture, one of the most striking characteristics of a soil is the color. Therefore, in the naming of soils in Illinois, a combination of color and texture, together with other descriptive terms when necessary, has been adopted so that the name in itself carries a definite description of a given soil type; as for example, "gray silt loam on tight clay," or "brown silt loam over gravel." The use of the prepositions *on* and *over* serves to indicate the presence of certain substrata. When the surface soil is underlain with material such as sand, gravel, or rock, the word *over* is used if this material lies at a depth greater than 30 inches; if it is less than 30 inches, the word *on* is used.

For further identification of soil types a system of numbering, resembling somewhat the Dewey library system, has been adopted whereby each soil type is assigned a certain number. This number indicates at once the geological origin of the soil as well as its physical description. The digits of the order of hundreds represent the geological area where the soil is found, beginning at 100 with the unglaciated, and following in series in the order of the enumeration presented in the paragraph above headed *Great Soil Areas In Illinois.* The digits of the orders of units and tens represent the various kinds of soil such as are enumerated above in the list of soil classes. A modification of a soil type called a *phase* is designated in this system by a figure placed at the right of the decimal point. To illustrate the working of this numbering system, suppose a soil type bears the number 726.5. The number 7 indicates that this soil occurs in the Iowan glaciation, the 26 that it is a brown silt loam, and the .5 that rock is found less than 30 inches below the surface. These numbers are especially useful in designating small areas on the map and as a check in reading the colors.

A complete list of the soil types occurring in each county, along with their corresponding type numbers and a description of the area covered, will be found in the respective county soil reports.

SOIL SURVEY METHODS

Mapping the Soil Types.—In conducting the soil survey, the county constitutes the unit of working area. In order that the survey be thoroly truthworthy it is necessary that careful, well-trained men be employed to do the mapping. The work is prosecuted to the best advantage by working in parties of from two to four. Only such men are placed in charge of these parties as are thoroly experienced in the work and have shown themselves to be especially well qualified in training and ability.

The men must be able to keep their location exactly and to recognize the different soil types, with their principal variations and limits, and they must show these upon the maps correctly. A definite system is employed in checking up this work. As an illustration, one man will survey and map a strip 80 rods or 160 rods wide and any convenient length, while his associate will work independently on another strip adjoining this area, and if the work is correctly done the soil-type boundaries will match up on the line between the two strips.

An accurate base map for field use is absolutely necessary for soil mapping. The base maps are prepared on a scale of one inch to the mile, the official data of the original or subsequent land survey being used as a basis in their construction. Each surveyor is provided with one of these base maps, which he carries with him in the field; and the soil-type boundaries, together with the streams, roads, railroads, canals, and town sites are placed in their proper locations upon the map while the mapper is on the area. Each section, or square mile, is divided into 40-acre plots on the map, and the surveyor must inspect every ten acres and determine the type or types of soil composing it. The different types are indicated on the map by different colors, pencils for this purpose being carried in the field.

A small auger 40 inches long forms for each man an invaluable tool with which he can quickly secure samples of the different strata for inspection. An extension for making the auger 80 inches long is taken by each party, so that any peculiarity of the deeper subsoil layers may be studied. Each man carries a compass to aid in keeping directions. Distances along roads are measured by an odometer attached to the axle of the vehicle or by some other measuring device, while distances in the field away from the roads are determined by pacing, an art in which the men become expert by practice. The soil boundaries can thus be located with as high a degree of accuracy as can be indicated by pencil on the scale of one inch to the mile.

Sampling for Analysis.—After all the soil types of a county have been located and mapped, samples representative of the different types are collected for chemical analysis. For this purpose usually three strata are sampled; namely, the surface (0 to 6⅔ inches), the subsurface (6⅔ to 20 inches), and the subsoil (20 to 40 inches). These strata correspond approximately, in the common kinds of soil, to 2,000,000 pounds of dry soil per acre in the surface layer, and to two times and three times this quantity in the subsurface and the subsoil, respectively.

By this system of sampling we have represented separately three zones for plant feeding. The surface layer includes at least as much soil as is ordinarily turned with the plow. This is the part with which the farm manure, limestone, phosphate, or other fertilizer applied in soil improvement is incorporated, and which must be depended upon in large part to furnish the necessary plant food for the production of crops. Even a rich subsoil has little or no value if it lies beneath a worn-out surface, but if the fertility of the surface soil is maintained at a high point, then the strong, vigorous plants will have power to secure more plant food from the subsurface and subsoil.

PRINCIPLES OF SOIL FERTILITY

Probably no agricultural fact is more generally known by farmers and landowners than that soils differ in productive power. Even tho plowed alike and at the same time, prepared the same way, planted the same day with the same kind of seed, and cultivated alike, watered by the same rains and warmed by the same sun, nevertheless the best acre may produce twice as large a crop as the poorest acre on the same farm, if not, indeed, in the same field; and the fact should be repeated and emphasized that with the normal rainfall of Illinois the productive power of the land depends primarily upon the stock of plant food contained in the soil and upon the rate at which it is liberated, just as the success of the merchant depends primarily upon his stock of goods and the rapidity of sales. In both cases the stock of any commodity must be increased or renewed whenever the supply of such commodity becomes so depleted as to limit the success of the business, whether on the farm or in the store.

CROP REQUIREMENTS

Ten different elements of plant food are essential for the growth and formation of every plant. These elements are: *carbon, oxygen, hydrogen, nitrogen, phosphorus, sulfur, potassium, magnesium, calcium, and iron;* and they are represented by the chemical symbols: C, O, H, N, P, S, K, Mg, Ca, and Fe. Some seasons in central Illinois are sufficiently favorable to allow the production of at least 50 bushels of wheat per acre, 100 bushels of corn, 100 bushels of oats, and 4 tons of clover hay. When such crops are not produced under favorable seasonal conditions, the failure is due to unfavorable soil condition, which may

TABLE A.—PLANT FOOD IN WHEAT, CORN, OATS, AND CLOVER

Produce		Nitrogen	Phosphorus	Sulfur	Potassium	Magnesium	Calcium	Iron
Kind	Amount							
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Wheat, grain	1 bu.	1.42	.24	.10	.26	.08	.02	.01
Wheat straw	1 ton	10.00	1.60	2.70	18.00	1.60	3.80	.60
Corn, grain	1 bu.	1.00	.17	.08	.19	.07	.01	.01
Corn stover	1 ton	16.00	2.00	2.42	17.33	3.33	7.00	1.60
Corn cobs	1 ton	4.00	.....	.....	4.00	.....	.....	.....
Oats, grain	1 bu.	.66	.11	.06	.16	.04	.02	.01
Oat straw	1 ton	12.40	2.00	4.14	20.80	2.80	6.00	1.12
Clover seed	1 bu.	1.75	.50	.....	.75	.25	.13	.....
Clover hay	1 ton	40.00	5.00	3.28	30.00	7.75	29.25	1.00

result from poor drainage, poor physical condition, or an actual deficiency of plant food.

Table A shows the plant-food requirements of some of our most common field crops with respect to the seven elements furnished by the soil. The figures show the weight in pounds of the various elements contained in a bushel or in a ton, as the case may be. From these data the amount of any element removed from an acre of land by a crop of a given yield can easily be computed.

It needs no argument to show that the continuous removal of such quantities of plant food without provision for their replacement must result sooner or later in soil depletion.

PLANT-FOOD SUPPLY

Of the ten elements of plant food, three *(carbon, oxygen,* and *hydrogen)* are secured from air and water, and seven from the soil. *Nitrogen,* one of these seven elements obtained from the soil by all plants, may also be secured from the air by one class of plants (legumes), in case the amount liberated from the soil is insufficient; but even these plants (which include only the clovers, peas, beans, and vetches among our common agricultural plants) are dependent upon the soil for the other six elements *(phosphorus, potassium, magnesium, calcium, iron, and sulfur)*, and they also utilize the soil nitrogen so far as it becomes soluble and available during their period of growth.

TABLE B.—PLANT-FOOD ELEMENTS IN MANURE, ROUGH FEEDS, AND FERTILIZERS

Material	Pounds of plant food per ton of material		
	Nitrogen	Phosphorus	Potassium
Fresh farm manure	10	2	8
Corn stover	16	2	17
Oat straw	12	2	21
Wheat straw	10	2	19
Clover hay	40	5	30
Cowpea hay	43	5	33
Alfalfa hay	50	4	24
Sweet clover (water-free basis)[1]	80	8	28
Dried blood	280	...	...
Sodium nitrate	310	...	...
Ammonium sulfate	400	...	...
Raw bone meal	80	180	...
Steamed bone meal	20	250	...
Raw rock phosphate	...	250	...
Acid phosphate	...	125	...
Potassium chlorid	...	...	850
Potassium sulfate	...	...	850
Kainit	...	...	200
Wood ashes[2]	...	10	100

[1]Young second year's growth ready to plow under as green manure.
[2]Wood ashes also contain about 1,000 pounds of lime (calcium carbonate) per ton.

The vast difference with respect to the supply of these essential plant food elements in different soils is well brought out in the data of the Illinois soil survey. For example, it has been found that the nitrogen in the surface 6⅔ inches, which represents the plowed stratum, varies in amount from 180 pounds per acre to nearly 33,000 pounds. In like manner the phosphorus content varies from about 420 pounds to 4,900 pounds, the potassium ranges from 1,530 pounds to about 58,000 pounds. Similar variations are found in all of the other essential plant food elements of the soil.

With these facts in mind it is easy to understand how a deficiency of one of these elements of plant food may become a limiting factor of crop production. When an element becomes so reduced in quantity as to become a limiting factor of production, then we must look for some outside source of supply. Table B is presented for the purpose of furnishing information regarding the quantity of plant food contained in some of the materials most commonly used as sources of plant-food supply.

LIBERATION OF PLANT FOOD

The chemical analysis of the soil gives the invoice of fertility actually present in the soil strata sampled and analyzed, but the rate of liberation is governed by many factors, some of which may be controlled by the farmer, while others are largely beyond his control. Chief among the important controllable factors which influence the liberation of plant food are limestone and decaying organic matter. Tillage also has a considerable effect in this connection.

Effect of Limestone.—Limestone corrects the acidity of the soil and thus encourages the development not only of the nitrogen-gathering bacteria which live in the nodules on the roots of clover, cowpeas, and other legumes, but also the nitrifying bacteria, which have power to transform the insoluble and unavailable organic nitrogen into soluble and available nitrate nitrogen. At the same time, the products of this decomposition have power to dissolve the minerals contained in the soil, such as potassium and magnesium, and also to dissolve the insoluble phosphate and limestone which may be applied in low-priced forms. Thus, in the conversion of sufficient organic nirogen into nitrate nitrogen for a 100-bushel crop of corn, the nitrous acid formed is alone sufficient to convert seven times as much insoluble tricalcium phosphate into soluble monocalcium phosphate as would be required to supply the phosphorus for the same crop.

Effect of Organic Matter.—Organic matter may be supplied by animal manures, consisting of the excreta of animals and usually accompanied by more or less stable litter, and by plant manures, including green-manure crops and cover crops plowed under and also crop residues such as stalks, straw, and chaff. The rate of decay of organic matter depends largely upon its age, condition, and origin, and it may be hastened by tillage. The chemical analysis shows correctly the total organic carbon, which constitutes, as a rule, but little more than half the organic matter; so that 20,000 pounds of organic carbon in the plowed soil of an acre corresponds to nearly 20 tons of organic matter. But this organic matter consists largely of the old organic residues that have accumulated during the past centuries because they were resistant to decay, and 2 tons of clover or cowpeas plowed under may have greater power to liberate plant food than the 20 tons of old, inactive organic matter. The history of the individual

farm or field must be depended upon for information concerning recent additions of active organic matter, whether in applications of farm manure, in legume crops, or in sods of old pastures.

The condition of the organic matter of the soil is indicated more or less definitely by the *ratio of carbon to nitrogen.* As an average, the fresh organic matter incorporated with soils contains about twenty times as much carbon as nitrogen, but the carbohydrates ferment and decompose much more rapidly than the nitrogenous matter; and the old resistant organic residues, such as are found in normal subsoils, commonly contain only five or six times as much carbon as nitrogen. Soils of normal physical composition, such as loam, clay loam, silt loam, and fine sandy loam, when in good productive condition, contain about twelve to fourteen times as much carbon as nitrogen in the surface soil; while in old, worn soils that are greatly in need of fresh, active, organic manures, the ratio is narrower, sometimes falling below ten of carbon to one or nitrogen. Except in newly made alluvial soils, the ratio is usually narrower in the subsurface and subsoil than in the surface stratum. Soils of cut-over or burnt-over timber lands sometimes contain so much partially decayed wood or charcoal as to destroy the value of the nitrogen-carbon ratio for the purpose indicated.

The organic matter furnishes food for bacteria, and as it decays certain decomposition products are formed, including much carbonic acid, some nitrous acid, and various organic acids, and these acting upon the soil have the power to dissolve the essential mineral plant foods, thus furnishing soluble phosphates, nitrates, and other salts of potassium, magnesium, calcium, etc., for the use of the growing crop.

Effect of Tillage.—Tillage, or cultivation, also hastens the liberation of plant food by permitting the air to enter the soil. It should be remembered, however, that tillage is wholly destructive, in that it adds nothing whatever to the soil, but always leaves it poorer, so far as plant food is concerned. Tillage should be practiced so far as is necessary to prepare a suitable seed bed for root development and also for the purpose of killing weeds, but more than this is unnecessary and unprofitable; and it is much better actually to enrich the soil by proper applications of limestone, organic matter and other fertilizing materials, and thus promote soil conditions favorable for vigorous plant growth, than to depend upon excessive cultivation to accomplish the same object at the expense of the soil.

PERMANENT SOIL IMPROVEMENT

According to the kind of soil involved, any comprehensive plan contemplating a permanent system of agriculture will need to take into account some of the following considerations.

The Application of Limestone

The Function of Limestone.—In considering the application of limestone to land it should be understood that this material functions in several different ways, and that a beneficial result may therefore be attributable to quite diverse causes: Limestone provides the plant food calcium, of which certain crops are strong feeders. It corrects acidity of the soil, thus making for some crops a much

more favorable environment as well as establishing conditions absolutely required for some of the beneficial legume bacteria. It accelerates nitrification and nitrogen fixation. It promotes sanitation of the soil by preventing the growth of certain fungus diseases, such as corn root rot. Experience indicates that it modifies directly the physical structure of some soils, frequently to their great improvement.

Thus, working in one or more of these different ways, limestone often becomes the key to the improvement of worn lands. Remarkable success has been experienced with limestone used in conjunction with sweet clover in the reclamation of abandoned hill land which had been ruined thru erosion.

Amounts to Apply.—If the soil is acid, at least 2 tons per acre of ground limestone should be applied as an initial treatment. Continue to apply limestone from time to time according to the requirement of the soil as indicated by the tests described below, or until the most favorable conditions are established for the growth of legumes, using preferably at times magnesian limestone ($CaCO_3MgCO_3$), which contains both calcium and magnesium and has slightly greater power to correct soil acidity, ton for ton, than the ordinary calcium limestone ($CaCO_3$). On strongly acid soils, or on land being prepared for alfalfa, 4 or 5 tons per acre of ground limestone may well be used for the first application.

How to Ascertain the Need for Limestone.—The need of a soil for limestone may be ascertained by applying one of the following tests for soil acidity. Along with the acidity test, a test for the presence of carbonates should be made. It should be understood that a positive test for carbonates does not guarantee the absence of acid; for it may happen, especially when the soil is near the neutral point, that positive tests for both acidity and carbonates are obtained. This condition is explained by the assumption that solid particles of calcium or magnesium carbonates form centers of alkalinity within a soil that is generally acid. Because of this fact any test made of a given soil ought to be repeated if it is to be thoroly reliable. It is also desirable to test samples from different depths. Following are the directions for making these tests:

The Litmus Paper Test for Acidity. Make a ball of fresh moist soil, break it in two, insert a piece of blue litmus paper, and press the soil firmly together again. After a few minutes examine the paper. If it has turned pink or red, soil acidity is indicated. The intensity of the color and the rapidity with which it develops indicates to some extent the amount of acidity. Needless to say the reliability of the test depends upon the quality of litmus paper used.

The Potassium Thiocyanate Test for Acidity. A more recently discovered test for soil acidity which promises to be more satisfactory than the litmus test is made with a 4-percent solution of potassium thiocyanate in alcohol—4 grams of potassium thiocyanate in 100 cubic centimeters of 95-percent alcohol (not denatured). When a small quantity of soil shaken up in a test tube with this solution gives a red color the soil is acid and limestone should be applied. If the solution remains colorless the soil is not acid. The conditions for a prompt reaction require a temperature that is comfortably warm.

The Hydrochloric Acid Test for Carbonates. Make a shallow cup of a ball of soil and pour into it a few drops of concentrated hydrochloric acid. If carbonates are present they are decomposed with the liberation of carbon dioxid, which appears as gas bubbles, producing foaming or effervescence. With much carbonate present the action is lively, but with mere traces of it the bubbles are given off slowly. If no carbonate, or very little, is indicated by the test, then it is advisable to apply limestone.

The Nitrogen Problem

Nitrogen presents the greatest practical soil problem in American agriculture. Four important reasons for this are: its increasing deficiency in most soils; its cost when purchased on the open market; its removal in large amounts by crops; and its loss from soils thru leaching. Nitrogen costs from four to

five times as much per pound as phosphorus. A 100-bushel crop of corn requires 150 pounds of nitrogen for its growth, but only 23 pounds of phosphorus. The loss of nitrogen from soils may vary from a few pounds to over one hundred pounds per acre, depending upon the treatment of the soil, the distribution of rainfall, and the protection afforded by growing crops.

An inexhaustible supply of nitrogen is present in the air. Above each acre of the earth's surface there are about sixty-nine million pounds of atmospheric nitrogen. The nitrogen above one square mile weighs twenty million tons, an amount sufficient to supply the entire world for four or five decades. This large supply of nitrogen in the air is the one to which the world must eventually turn.

There are two methods of collecting the inert nitrogen gas of the air and combining it into compounds that will furnish products for agricultural uses. *These are the chemical and the biological fixation of the atmospheric nitrogen.* Farmers have at their command one of these methods. By growing inoculated legumes, nitrogen may be obtained from the air, and by plowing under more than the roots of those legumes, nitrogen may be added to the soil.

Inasmuch as legumes are worth growing for feed and seed as well as for nitrate production, a considerable portion of the nitrogen thus gained may be considered a by-product. Because of that fact, it is questionable whether the chemical fixation of nitrogen, the possibilities of which now represent numerous compounds, will ever be able to replace the simple method of obtaining atmospheric nitrogen by growing inoculated legumes.

For easy figuring it may well be kept in mind that the following amounts of nitrogen are required for the produce named:

1 bushel of oats (grain and straw) requires 1 pound of nitrogen.
1 bushel of corn (grain and stalks) requires 1½ pounds of nitrogen.
1 bushel of wheat (grain and straw) requires 2 pounds of nitrogen.
1 ton of timothy requires 24 pounds of nitrogen.
1 ton of clover contains 40 pounds of nitrogen.
1 ton of cowpeas contains 43 pounds of nitrogen.
1 ton of alfalfa contains 50 pounds of nitrogen.
1 ton of average manure contains 10 pounds of nitrogen.
1 ton of young sweet clover, at about the stage of growth when it is plowed under as green manure, contains, on water-free basis, 80 pounds of nitrogen.

The roots of clover contain about half as much nitrogen as the tops, and the roots of cowpeas contain about one-tenth as much as the tops. Soils of moderate productive power will furnish as much nitrogen to clover (and two or three times as much to cowpeas) as will be left in the roots and stubble. In grain crops, such as wheat, corn, and oats, about two-thirds of the nitrogen is contained in the grain and one-third in the straw or stalks.

The Phosphorus Problem

The element phosphorus is an indispensable constituent of every living cell. It is intimately connected with the life processes of both plants and animals, the nuclear material of the cells being especially rich in this element.

The phosphorus content of a soil varies according to its origin and the kind of farming practiced. Even virgin soils are found that are deficient in phosphorus.

On all lands deficient in phosphorus (except on those susceptible to serious erosion by surface washing or gullying) that element should be applied in considerably larger amounts than are required to meet the actual needs of the crops desired to be produced. The abundant information thus far secured shows positively that fine-ground natural rock phosphate can be used successfully and very profitably, and clearly indicates that this material will be the most economical form of phosphorus to use in all ordinary systems of permanent, profitable soil improvement. The first application may well be one ton per acre, and subsequently about one-half ton per acre every four or five years should be applied, at least until the phosphorus content of the plowed soil reaches 2,000 pounds per acre, which may require a total application of from 3 to 5 or 6 tons per acre of raw phosphate containing 12½ percent of the element phosphorus.

Steamed bone meal and even acid phosphate may be used in emergencies, but it should always be kept in mind that a pound of phosphorus delivered in Illinois in the form of raw phosphate (direct from the mine in carload lots), is much cheaper than the same amount in steamed bone meal or in acid phosphate, both of which cost too much per ton to permit their common purchase by farmers in carload lots, which is not the case with raw phosphate. Landowners should bear in mind the fact that phosphorus additions to the soil in amounts above the immediate crop requirements represent a permanent investment, since this element is not readily lost in the drainage water as in the case of nitrogen. It is removed from the farm thru the sale of crops, milk, and animals.

Phosphate may be applied at any time during a rotation, but it is applied to the best advantage either preceding a crop of clover, which plant seems to possess an unusual power for assimilating raw phosphate, or else at a time when it can be plowed under with some form of organic matter such as animal manure or green manure, the decay of which serves to liberate the phosphorus from its insoluble condition in the rock. It is important that the fine-ground rock phosphate be intimately mixed with the organic material as it is plowed under.

The Potassium Problem

Normal soils, in which clay and silt form a considerable part of the constituency, are well stocked with potassium, altho it exists largely in insoluble form. Such soils as sands and peats, however, are likely to be low in this element. On such soils this deficiency may be supplied by the application of some potassium salt, such as potassium sulfate, potassium chlorid, kainit, or other potassium compound, and in many instances this is done at great profit.

From all the facts at hand it seems, so far as our great areas of normal soils are concerned, that the potassium problem is not one of addition but of liberation. The Rothamsted records, which represent the oldest soil experiment fields in the world, show that for many years other soluble salts have practically the same power as potassium to increase crop yield in the absence of sufficient decaying organic matter. Whether this action relates to supplying or liberating potassium for its own sake, or to the power of the soluble salt to increase the availability of phosphorus or other elements, is not known, but where much

potassium is removed, as in the entire crops at Rothamsted, with no return of organic residues, probably the soluble salt functions in both ways.

Further evidence on this matter is furnished by the Illinois experiment field at Fairfield, where potassium sulfate has been compared with kainit both with and without the addition of organic matter in the form of stable manure. Both sulfate and kainit produced a substantial increase in the yield of corn, but the cheaper salt, kainit, was just as effective as the potassium sulfate, and returned some financial profit. Manure alone gave an increase similar to that produced by the potassium salts, but the salts added to the manure gave very little increase over that produced by the manure alone. This is explained in part perhaps because the potassium removed in the crops is mostly returned in the manure if properly cared for, and perhaps in larger part because the decaying organic matter helps to liberate and hold in solution other plant-food elements, especially phosphorus.

In laboratory experiments at the Illinois Experiment Station, it has been shown that potassium salts and most other soluble salts increase the solubility of the phosphorus in soil and in rock phosphate; also that the addition of glucose with rock phosphate in pot-culture experiments increases the availability of the phosphorus, as measured by plant growth, altho the glucose consists only of carbon, hydrogen, and oxygen, and thus contains no plant food of value.

In considering the conservation of potassium on the farm it should be remembered that in average live-stock farming the animals destroy two-thirds of the organic matter and retain one-fourth of the nitrogen and phosphorus from the food they consume, but that they retain less than one-tenth of the potassium; so that the actual loss of potassium in the products sold from the farm, either in grain farming or in live-stock farming, is negligible on land containing 25,000 pounds or more of potassium in the surface 6⅔ inches.

The Calcium and Magnesium Problem

When measured by the actual crop requirements for plant food, magnesium and calcium are more limited in some Illinois soils than potassium. But with these elements we must also consider the loss by leaching.

Doctor Edward Bartow and associates, of the Illinois State Water Survey, have shown that as an average of 90 analyses of Illinois well-waters drawn chiefly from glacial sands, gravels, or till, 3 million pounds of water (about the average annual drainage per acre for Illinois) contained 11 pounds of potassium, 130 of magnesium, and 330 of calcium. These figures are very significant, and it may be stated that if the plowed soil is well supplied with the carbonates of magnesium and calcium, then a very considerable proportion of these amounts will be leached from that stratum. Thus the loss of calcium from the plowed soil of an acre at Rothamsted, England, where the soil contains plenty of limestone, has averaged more than 300 pounds a year as determined by analyzing the soil in 1865 and again in 1905. And practically the same amount of calcium was found by analyzing the Rothamsted drainage waters.

Common limestone, which is calcium carbonate ($CaCO_3$), contains, when pure, 40 percent of calcium, so that 800 pounds of limestone is equivalent to 320 pounds of calcium. Where 10 tons per acre of ground limestone was applied at Edgewood, Illinois, the average annual loss during the next ten

years amounted to 790 pounds per acre. The definite data from careful investigations seems to be ample to justify the conclusion that where limestone is needed at least 2 tons per acre should be applied every four or five years.

It is of interest to note that thirty crops of clover of 4 tons each would require 3,510 pounds of calcium, while the most common prairie land of southern Illinois contains only 3,420 pounds of total calcium in the plowed soil of an acre. Thus limestone has a positive value on some soils for the plant food which it supplies, in addition to its value in correcting soil acidity and in improving the physical condition of the soil. Ordinary limestone (abundant in the southern and western parts of the state) contains nearly 800 pounds of calcium per ton; while a good grade of dolomitic limestone (the more common limestone of northern Illinois) contains about 400 pounds of calcium and 300 pounds of magnesium per ton. Both of these elements are furnished in readily available form in ground dolomitic limestone.

The Sulfur Question

In considering the relation of sulfur in a permanent system of soil fertility it is important to understand something of the cycle of transformations that this element undergoes in nature. Briefly stated this is as follows:

Sulfur exists in the soil in both organic and inorganic forms, the former being gradually converted to the latter form thru bacterial action. In this inorganic form sulfur is taken up by plants which in their physiological processes change it once more into an organic form as a constituent of protein. When these plant proteins are consumed by animals, the sulfur becomes a part of the animal protein. When these plant and animal proteins are decomposed, either thru bacterial action, or thru combustion, the sulfur passes into the atmosphere or into the soil solution in the form of sulfur dioxid gas. This gas unites with oxygen and water to form sulfuric acid, which is readily washed back into the soil by the rain, thus completing the cycle, from soil—to plants and animals —to air—to soil.

In this way sulfur becomes largely a self-renewing element of the soil, altho there is a considerable loss from the soil by leaching. Observations taken at the Illinois Agricultural Experiment Station show that 40 pounds of sulfur per acre are brought into the soil thru the annual rainfall. With a fair stock of surfur, such as exists in our common types of soil, and an annual return, which of itself would more than suffice for the needs of maximum crops, the maintenance of an adequate sulfur supply presents little reason at present for serious concern. There are regions, however, where the natural stock of sulfur in the soil is not nearly so high and where the amount returned thru rainfall is small. Under such circumstances sulfur soon becomes a limiting element of crop production, and it will be necessary sooner or later to introduce this substance from some outside source. Investigation is now under way to determine to what extent this situation may apply to conditions in Illinois.

Physical Improvement of Soils

In the management of most soil types, one very important thing, aside from proper fertilization, tillage, and drainage, is to keep the soil in good physical condition, or good tilth. The constituent most important for this purpose is

organic matter. Organic matter in producing good tilth helps to control washing of soil on rolling land; raises the temperature of drained soil, increases the moisture-holding capacity of the soil, retards capillary rise and consequently loss of moisture by surface evaporation, and helps to overcome the tendency of some soils to run together badly.

The physical effect of organic matter is to produce a granulation or mellowness, by cementing the fine soil particles into crumbs or grains about as large as grains of sand, which produces a condition very favorable for tillage, percolation of rainfall, and the development of plant roots.

Organic matter is being destroyed during a large part of the year and the nitrates produced in its decomposition are used for plant growth. Altho this decomposition is necessary, it nevertheless reduces the amount of organic matter, and provision must therefore be made for maintaining the supply. The practical way to do this is to turn under the farm manure, straw, corn stalks, weeds, and all or part of the legumes produced on the farm. The amount of legumes needed depends upon the character of the soil. There are farms, especially grain farms, in nearly every community where all legumes could be turned under for several years to good advantage.

Manure should be spread upon the land as soon as possible after it is produced, for if it is allowed to lie in the barnyard several months as is so often the case, from one-third to two-thirds of the organic matter will be lost.

Straw and corn stalks should be turned under, and not burned. Probably no form of organic matter acts more beneficially in producing good tilth than corn stalks. It is true, they decay rather slowly, but it is also true that their durability in the soil is exactly what is needed in the production of good tilth. Furthermore, the nitrogen in a ton of corn stalks is one and one-half times that of a ton of manure, and a ton of dry corn stalks incorporated in the soil will ultimately furnish as much humus as four tons of average farm manure. When burned, however, both the humus-making material and the nitrogen are lost to the soil.

It is a common practice in the corn belt to pasture the corn stalks during the winter and often rather late in the spring after the frost is out of the ground. This tramping by stock sometimes puts the soil in bad condition for working. It becomes partially puddled and will be cloddy as a result. If tramped too late in the spring, the natural agencies of freezing and thawing and wetting and drying, with the aid of ordinary tillage, fail to produce good tilth before the crop is planted. Whether the crop is corn or oats, it necessarily suffers, and if the season is dry, much damage may be done. If the field is put in corn, a poor stand is likely to result, and if put in oats, the soil is so compact as to be unfavorable for their growth. Sometimes the soil is worked when too wet. This also produces a partial puddling which is unfavorable to physical, chemical, and biological processes. The bad effect will be greater if cropping has reduced the organic matter below the amount necessary to maintain good tilth.

Systems of Crop Rotations

In a program of permanent soil improvement one should adopt at the outset a good rotation of crops, including a liberal use of legumes, in order to increase the organic matter of the soil either by plowing under the legume crops and

other crop residues (straw and corn stalks), or by using for feed and bedding practically all the crops raised and returning the manure to the land with the least possible loss. No one can say in advance for every particular case what will prove to be the best rotation of crops, because of variation in farms and farmers and in prices for produce.

Following are a few suggested rotations, applicable to the corn belt, which may serve as models or outlines to be modified according to special circumstances.

Six-Year Rotations

First year —Corn
Second year —Corn
Third year —Wheat or oats (with clover or clover and grass)
Fourth year —Clover, or clover and grass
Fifth year —Wheat (with clover) or grass and clover
Sixth year —Clover, or clover and grass

Of course there should be as many fields as there are years in the rotation. In grain farming, with small grain grown the third and fifth years, most of the unsalable products should be returned to the soil, and the clover may be clipped and left on the land or returned after threshing out the seed (only the clover seed being sold the fourth and sixth years); or, in live-stock farming, the field may be used three years for timothy and clover pasture and meadow if desired. The system may be reduced to a five-year rotation by cutting out either the second or the sixth year, and to a four-year system by omitting the fifth and sixth years, as indicated below.

Five-Year Rotations

First year —Corn
Second year —Wheat or oats (with clover, or clover and grass)
Third year —Clover, or clover and grass
Fourth year —Wheat (with clover), or clover and grass
Fifth year —Clover, or clover and grass

First year —Corn
Second year —Corn
Third year —Wheat or oats (with clover, or clover and grass)
Fourth year —Clover, or clover and grass
Fifth year —Wheat (with clover)

First year —Corn
Second year —Cowpeas or soybeans
Third year —Wheat (with clover)
Fourth year —Clover
Fifth year —Wheat (with clover)

The last rotation mentioned above allows legumes to be seeded four times. Alfalfa may be grown on a sixth field for five or six years in the combination rotation, alternating between two fields every five years, or rotating over all the fields if moved every six years.

Four-Year Rotations

First year —Wheat (with clover)
Second year —Corn
Third year —Oats (with clover)
Fourth year —Clover

First year —Corn
Second year —Corn
Third year —Wheat or oats (with clover)
Fourth year —Clover

First year —Corn
Second year —Wheat or oats (with colver)
Third year —Clover
Fourth year —Wheat (with clover)

First year —Wheat (with clover)
Second year —Clover
Third year —Corn
Fourth year —Oats (with clover)

First year —Corn
Second year —Cowpeas or soybeans
Third year —Wheat (with clover)
Fourth year —Clover

Alfalfa may be grown on a fifth field for four or eight years, which is to be alternated with one of the four; or the alfalfa may be moved every five years, and thus rotated over all five fields every twenty-five years.

Three-Year Rotations

First year —Corn
Second year —Oats or wheat (with clover)
Third year —Clover

First year —Wheat (with clover)
Second year —Corn
Third year —Cowpeas or soybeans

By allowing the clover, in the last rotation mentioned, to grow in the spring before preparing the land for corn, we have provided a system in which legumes grow on every acre every year. This is likewise true of the following suggested two-year system:

Two-Year Rotation

First year —Oats or wheat (with sweet clover)
Second year —Corn

Altho in this two-year rotation either oats or wheat is suggested, as a matter of fact, by dividing the land devoted to small grain, both of these crops can be grown simultaneously, thus providing a three-crop system in a two-year cycle.

It should be understood that in all of the above suggested cropping systems it may be desirable in some cases to substitute rye for the wheat or oats. In all of these proposed rotations the word *clover* is used in a general sense to designate either red clover, alsike clover, or sweet clover. The value of sweet clover especially as a green manure for building up depleted soils, as well as a pasture and hay crop, is becoming thoroly established, and its importance in a crop-rotation program may well be emphasized.

SUPPLEMENT: EXPERIMENT FIELD DATA

(Results from Experiment Fields Representing the More Important Types of Soil Occurring in McHenry County)

In the earlier reports of this series it was the practice to incorporate in the body of the report the results of certain experiment fields, for the purpose of illustrating the possibilities of improving the soil of various types. The information carried by such data must, naturally, be considered more or less tentative. As the fields grow older new facts develop, which in some instances may call for the modification of former recommendations. It has therefore seemed desirable to separate this experiment field data from the more permanent information of the soil survey, and embody the same in the form of a supplement to the soil report proper, thus providing a convenient arrangement for possible future revisions as further data accumulate.

The University of Illinois has conducted altogether about fifty soil experiment fields in different sections of the state and on various types of soil. Altho some of these fields have been discontinued, the large majority are still in operation. It is the present purpose to report the summarized results from certain of these fields which are representative of the types of soil described in the accompanying soil report.

A few general explanations at this point, which apply to all the fields, will relieve the necessity of numerous repetitions in the following pages.

These fields vary in size from less than two acres up to 40 acres or more. They are laid off into series of plots and each series is occupied by one kind of crop. Usually there are several series so that a crop rotation can be carried on with every crop represented every year.

Farming Systems

On many of the fields the treatment provides for two distinct systems of farming, live-stock and grain farming. *In the live-stock system,* stable manure is used to furnish organic matter and nitrogen. The amount applied to a plot is based upon the amount that can be produced from crops raised on that plot.

In the grain system no animal manure is used. The organic matter and nitrogen are supplied in the form of plant manures, including plant residues produced, such as stalks and straw, along with leguminous catch crops plowed under.

Rotations

Crops which are of interest in the respective localities are grown in definite rotations, and on most of the fields provision is made so that every crop in the rotation is represented every year. The most common rotation used is wheat, corn, oats, and clover; and often these crops are accompanied by alfalfa growing on a fifth series. In the grain system a legume catch crop, usually sweet clover, is included, which is seeded on the young wheat in the spring and plowed under in the fall or in the following spring in preparation for corn. In the event of clover failure, soybeans are substituted.

Soil Treatment

The treatment applied to the plots has, for the most part, been standardized according to a definite system, altho deviations from this system occur now and then, particularly in the older fields.

Following is a brief explanation of this standard system of treatment.

Animal Manures.—Animal manures, consisting of excreta from animals, with stable litter, are spread upon the respective plots in amounts proportionate to previous crop yields, the applications being made in the preparation for corn.

Plant Manures.—All crop residues produced on the land, such as stalks, straw, and chaff, are returned to the soil, and in addition a green-manure crop of sweet clover is seeded in small grains to be plowed under in preparation for corn. (On plots where limestone is lacking the sweet clover seldom survives.) This practice is designated as the *residues system.*

Mineral Manures.—The yearly acre-rates of application are: for limestone, 1,000 pounds; for raw rock phosphate, 500 pounds; and for potassium, the equivalent of 200 pounds of kainit. The initial application of limestone is usually 4 tons per acre.

Explanation of Symbols Used

0 = Untreated land or check plots
M = Manure (animal)
R = Residues (from crops, and includes legumes used as green manure)
L = Limestone
P = Phosphorus
K = Potassium (usually in the form of kainit)
N = Nitrogen (usually in the form contained in dried blood)
( ) = Parentheses enclosing figures signify tons of hay, as distinguished from bushels of seed

In discussions of this sort of data, financial profits or losses based upon assigned market values are frequently considered. However, in view of the erratic fluctuations in market values—especially in the past few years—it seems futile to attempt to set any prices for this purpose that are at all satisfactory. The yields are therefore presented with the thought that with these figures at hand the financial returns from a given practice can readily be computed upon the basis of any set of market values that the reader may choose to apply.

BROWN SILT LOAM

Several experiment fields have been conducted on brown silt loam soil at various locations in Illinois. Those located at the University have been in operation the longest and they serve well to illustrate the principles involved in the maintenance and improvement of this type of soil.

The Morrow Plots

It happens that the oldest soil experiment field in the United States is located on typical brown silt loam of the early Wisconsin glaciation, on the campus of the University of Illinois. This field was started in 1879 by George E. Morrow, who for many years was Professor of Agriculture, and these plots are known as the Morrow plots.

TABLE 1.—URBANA FIELD, MORROW PLOTS: BROWN SILT LOAM; PRAIRIE; EARLY WISCONSIN GLACIATION

Crop Yields in Soil Experiments—Bushels or (tons) per acre

Years	Soil treatment applied	Corn every year	Two-year rotation		Three-year rotation		
		Corn	Corn	Oats	Corn	Oats	Clover
1879–87	None	....	....	....	....	....	....
1888	None	54.3	49.5	....	....	48.6	....
1889	None	43.2	....	37.4	....	....	(4.04)
1890	None	48.7	54.3	....	....	....	(1.51)
1891	None	28.6	33.2	....	....	....	(1.46)
1892	None	33.1	....	37.2	70.2	....	....
1893	None	21.7	29.6	....	34.1	....	....
1894	None	34.8	....	57.2	....	65.1	....
1895	None	42.2	41.6	....	....	22.2	....
1896	None	62.3	....	34.5	....	....	....
1897	None	40.1	47.0	....	....	....	....
1898	None	18.1	....	....	....	....	....
1899	None	50.1	44.4	....	53.5	....	....
1900	None	48.0	....	41.5	....	....	....
1901	None	23.7	33.7	....	34.3	....	....
1902	None	60.2	....	56.3	....	54.6	....
1903	None	26.0	35.9	....	....	....	(1.11)
1904	None	21.5	....	17.5	55.3	....	....
1904	MLP	17.1	....	25.3	72.7	....	....
1905	None	24.8	50.0	....	....	42.3	....
1905	MLP	31.4	44.9	....	....	50.6	....
1906	None	27.1	....	34.7	....	....	(1.42)[1]
1906	MLP	35.8	....	52.4	....	....	(1.74)[1]
1907	None	29.0	47.8	....	80.5	....	....
1907	MLP	48.7	87.6	....	93.6	....	....
1908	None	13.4	....	32.9	....	40.0	....
1908	MLP	28.0	....	45.0	....	44.4	....
1909	None	26.6	33.0	....	....	....	(.65)[2]
1909	MLP	31.6	64.8	....	....	....	(1.73)[3]
1910	None	35.9	....	33.8	58.6	....	....
1910	MLP	54.6	....	59.4	83.3	....	....
1911	None	21.9	28.6	....	....	20.6	....
1911	MLP	31.5	46.3	....	....	38.0	....
1912	None	43.2	....	55.0	....	....	16.3[1]
1912	MLP	64.2	....	81.0	....	....	20.0[1]
1913	None	19.4	29.2	....	33.8	....	....
1913	MLP	32.0	25.0	....	47.8	....	....
1914	None	31.6	....	33.6	....	39.6	....
1914	MLP	39.4	....	58.2	....	60.4	....
1915	None	40.0	49.0	....	....	....	24.2[1]
1915	MLP	66.0	81.2	....	....	....	27.1[1]
1916	None	11.2	....	37.5	27.8	....	....
1916	MLP	10.8	....	64.7	40.6	....	....
1917	None	40.0	48.4	....	....	68.4	....
1917	MLP	78.0	81.4	....	....	86.9	....
1918	None	13.6	....	27.2	....	....	(2.58)
1918	MLP	32.6	....	59.3	....	....	(4.04)
1919	None	24.0	30.8	....	52.2	....	....
1919	MLP	43.4	66.2	....	70.8	....	....
1920	None	28.2	....	37.2	....	52.2	....
1920	MLP	54.4	....	51.6	....	69.7	....

[1]Soybeans.
[2]In addition to the hay, .64 bushel of seed was harvested.
[3]In addition to the hay, 1.17 bushels of seed were harvested.

TABLE 2.—URBANA FIELD, MORROW PLOTS: GENERAL SUMMARY
Bushels or (tons) per acre

Years	Soil treatment applied	Corn every year	Two-year rotation		Three-year rotation		
			Corn	Oats	Corn	Oats	Clover
		16 crops	*9 crops*	*6 crops*	*4 crops*	*4 crops*	*4 crops*
1888 to 1903	None.....	39.7	41.0	44.0	48.0	47.6	(2.03)
		17 crops	*8 crops*	*9 crops*	*6 crops*	*6 crops*	*3 crops*
1904 to 1920	None.....	26.6	39.6	34.4	51.4	43.9	(1.55)[1]
	MLP.....	41.1	62.2	55.2	68.1	58.3	(2.50)[1]

[1]One crop of soybean hay.

The Morrow series now consists of three plots divided into halves and the halves are subdivided into quarters. On one plot corn is grown continuously; on the second corn and oats are grown in rotation; and on the third, corn, oats, and clover are rotated. The north half of each plot has had no fertilizing material applied from the beginning of the experiments, while the south half has been treated since 1904, receiving standard applications of farm manure with cover crops grown in the one-crop and two-crop systems. Phosphorus has been applied in two different forms: rock phosphate to the southwest quarter at the rate of 600 pounds, and steamed bone meal to the southeast quarter at the rate of 200 pounds per acre per year up to 1919, when the rock phosphate was increased sufficiently to bring up the total amount applied to four times the quantity of bone meal applied. At the same time the rate of subsequent application of both forms of phosphorus was reduced to one-fourth the quantity, or to 200 pounds of rock phosphate and 50 pounds of bone meal per acre per year. In 1904 ground limestone was applied at the rate of 1,700 pounds per acre to the south half of each plot, and in 1918 a further application was made at the rate of 5 tons per acre with the intention of standardizing the application to the rate of 1,000 pounds of limestone per acre per year.

FIG. 1.—CORN ON THE MORROW PLOTS IN 1910

Table 1 gives the yearly records of the crop yields, and Table 2 presents the same in summarized form.

Summarizing the data from these Morrow plots into two periods with the second period beginning in 1904 when the treatment began on the half-plots, some interesting comparisons may be made. In the first place we find in the continuous corn plot a marked decrease in the second period in the average yield of corn, amounting to one-third of the crop. In the two-year rotation there is a decrease in both corn and oats production, while the averages for the three-year system show an increase in corn yield and decreases in oats and clover. Unfortunately the numbers of crops included in these last averages are too small to warrant positive conclusions.

The increase brought about by soil treatment stands out in all cases, showing the possibility not only of restoring but also of greatly improving the productive power of this land that has been so abused by continuous cropping without fertilization.

The Davenport Plots

Another set of plots on the University campus at Urbana, forming a more extensive series than the Morrow plots, but of more recent origin, are the Davenport plots. Here each crop in the rotation is represented every year. These plots were laid out in 1895, but special soil treatment was not begun until 1901. They now comprize five series of ten plots each, and each series constitutes a "field" in a crop rotation system.

From 1901 to 1911 three of the series were in a three-year rotation system of corn, oats, and clover, while the remaining two series rotated in corn and oats. In 1911 these two systems were combined into a five-series field, with a crop rotation of wheat, corn, oats, and clover, with alfalfa on a fifth field. The alfalfa occupies one series during a rotation of the other four crops, shifting to another series in the fifth year, thus completing the cycle of all series in twenty-five years.

The soil treatment applied to these plots has been as follows:

Legume cover crops were seeded in the corn at the last cultivation on Plots 2, 4, 6, and 8, from 1902 to 1907, but the growth was small and the effect, if any, was to decrease the returns from the regular crops. Crop residues (**R**) have been returned to these same plots since 1907. These consist of stalks and straw, and all legumes except alfalfa hay and the seed of clover and soybeans. Beginning in 1918 a modification of the practice was made in that one cutting of the red clover crop is harvested as hay. In conjunction with these residues a catch crop of sweet clover grown with the wheat is plowed under.

Manure (**M**) was applied preceding corn, at the rate of 2 tons per acre per year in 1905, 1906, and 1907; subsequently as many tons have been applied as there have been tons of air-dry produce harvested from the respective plots.

Lime (**L**) was applied on Plots 4 to 10 at the rate per acre of 250 pounds of air-slaked lime in 1902, and 600 pounds of limestone in 1903. No further application was made until 1911, when the system of cropping was changed. Since that time applications of limestone have been made at the rate of one-half ton per acre per year.

Phosphorus (**P**) was applied on Plots 6 to 9 at the rate of 25 pounds per acre per annum in 200 pounds of steamed bone meal; but beginning with 1908 rock phosphate at the rate of 600 pounds per acre per annum was substi-

TABLE 3.—URBANA FIELD, DAVENPORT PLOTS: BROWN SILT LOAM, PRAIRIE; EARLY WISCONSIN GLACIATION

Ten-Year Average Annual Yields—Bushels or (tons) per acre
1911-1920

Serial plot No.	Soil treatment applied	Corn	Oats	Wheat	Clover 5 crops	Soybeans 5 crops	Alfalfa
1	0	55.6	50.5	26.0	(2.42)	(1.47)	(2.43)
2	R	57.1	52.3	28.7	1.47[1]	19.8	(2.46)
3	M	66.3	61.9	28.2	(2.56)	(1.62)	(2.52)
4	RL	64.8	55.6	31.4	1.61[1]	20.3	(2.72)
5	ML	69.6	64.1	32.8	(2.90)	(1.67)	(3.03)
6	RLP	71.5	69.8	43.0	2.29[1]	23.5	(3.69)
7	MLP	73.0	68.6	40.0	(3.52)	(1.97)	(3.76)
8	RLPK	70.9	72.5	40.7	1.79[1]	25.5	(3.77)
9	MLPK	70.2	72.0	39.2	(3.40)	(2.20)	(3.73)
10	Mx5LPx5	65.9	71.4	40.6	(3.31)	(2.22)	(3.77)

[1]In addition to the clover seed, a crop of hay was harvested one year on Plots 2, 4, 6, and 8, yielding 2.38, 2.20, 2.54, and 2.39 tons, respectively.

tuted for the bone meal on one-half of each of these plots. These applications continued until 1918 when adjustments were begun, first to make the rate of application of rock phosphate four times that of the bone meal, and finally to reduce the amounts of these materials to 200 pounds of rock phosphate and 50 pounds of bone meal per acre per annum. The usual practice has been to apply and plow under at one time all phosphorus and potassium required for the rotation.

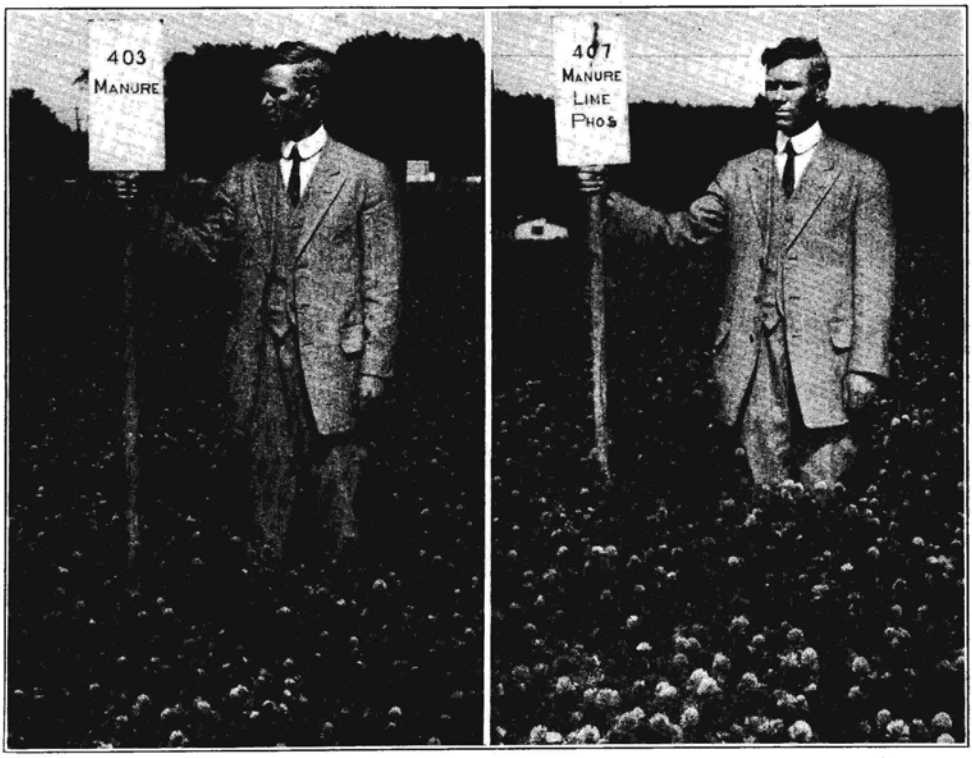
Potassium (**K** = kalium) has been applied on Plots 8 and 9 in connection with the bone meal and rock phosphate, at the yearly rate of 42 pounds per acre, and mainly as potassium sulfate.

On Plot 10 about five times as much manure and phosphorus are applied as on the other plots, but this "extra heavy" treatment was not begun until 1906, only the usual lime, phosphorus, and potassium having been applied in previous years. The purpose in making these heavy applications is to try to determine the climatic possibilities in crop yields by removing the limitations of inadequate fertility.

It will be observed that the applications described above provide for the two rather distinct systems of farming already described. *The grain system,* in which animal manure is not produced and where the organic matter is provided by the direct return to the soil of all crop residues, is exemplified in Plots 2, 4, 6, and 8; and the *live-stock system,* in which farm manure is utilized for soil enrichment, is represented in Plots 3, 5, 7, and 9.

Table 3 shows a summary of the results obtained on the Davenport plots beginning with the year 1911, when the present cropping system was introduced.

When used in conjunction with phosphorus the crop residues and the manure appear about equally effective; but where phosphorus is not applied, the manure has been decidedly more effective, under the conditions of the experiment. It should be observed, however, in this connection, that the plowing under of clover is a very essential feature of the residues system, and that, as a matter of fact, there were five clover failures, when soybeans were substituted, during the ten years. Perhaps with a more reliable biennial legume than red clover, the results would have been more favorable for this system.



Manure
Yield: 1.43 tons per acre

Manure, limestone, phosphorus
Yield: 2.90 tons per acre

FIG. 2.—CLOVER ON THE DAVENPORT PLOTS IN 1913

By comparing Plots 2 and 3 with Plots 4 and 5, it is found that limestone has had a beneficial effect on all crops. What the financial profit amounts to depends obviously upon the market value of the crops and the cost of the limestone.

Comparing Plots 4 and 5 with Plots 6 and 7, respectively, there is found in all cases an increase in crop yield as a result of adding phosphorus. The effect on wheat is especially pronounced. Where limestone and phosphorus are applied in addition to the crop residues, an increase of 17 bushels of wheat, over the yield of the untreated land, has been obtained as a ten-year average.

The effect of adding potassium to the treatment is of much interest. Plots 8 and 9 are the same as Plots 6 and 7, respectively, except that potassium has been applied to the former. On the whole, no significant benefit is shown from the addition of potassium.

No benefit appears as the result of the extra-heavy applications of manure and phosphorus on Plot 10. In fact the corn yields are noticeably less here than on the plots receiving the normal applications of these materials.

The University South Farm

On the University South Farm, at Urbana, several series of plots devoted primarily to variety testing and other crop-production experiments are so laid out as to show the effects of certain soil treatments that have been applied.

Several different systems of crop rotation are employed and the crops are so handled as to exemplify the two general systems of farming, grain and livestock.

The summarized results presented in Table 4 represent three different systems of cropping. The first, designated as the Southwest rotation, is to be regarded as a good rotation for general practice, on this type of soil, under Illinois conditions. This is a four-field rotation of wheat, corn, oats, and clover. The second, or North-Central rotation, consisting of corn, corn, oats, and clover, represents a system very commonly practiced; and the third or South-Central rotation, consisting of corn, corn, corn, and soybeans, must be considered as a poor rotation from the standpoint of maintaining the productiveness of the land.

TABLE 4.—URBANA FIELD, SOUTH FARM: BROWN SILT LOAM, PRAIRIE; EARLY WISCONSIN GLACIATION

Average Annual Yields—Bushels or (tons) per acre

Southwest Rotation: Series 100, 200, 400[1]: Wheat, Corn, Oats, Clover[2]

Soil treatment applied[6]	Corn 9 crops	Oats[3] 9 crops	Wheat[3] 8 crops	Clover[4] 3 crops	Soybeans 7 crops
RP	62.3	51.9	41.0	1.05	17.3[5]
R	51.9	46.5	26.9	1.38	16.2[5]
M	59.7	50.2	29.1	(2.28)	(1.25)
MP	64.3	55.4	43.1	(2.86)	(1.51)
RLP	60.5	57.2	41.8	.64	16.4[5]
R	49.7	49.6	25.8	.83	14.7[5]
M	55.5	54.1	27.8	(1.71)	(1.28)
MLP	64.1	59.6	43.9	(1.77)	(1.58)

North-Central Rotation: Series 500, 600, 700[1]: Corn, Corn, Oats, Clover[2]

Soil treatment applied[6]	Corn 1st year 9 crops	Corn 2d year 9 crops	Oats 9 crops	Clover 5 crops	Soybeans 4 crops
RP	56.7	51.1	56.1	.54	16.9
R	51.7	45.2	52.0	.50	16.0
M	54.9	46.7	52.1	(2.29)	(1.60)
MP	56.5	53.4	56.9	(2.73)	(1.74)

South-Central Rotation: Series 500, 600, 700[1]: Corn, Corn, Corn, Soybeans

Soil treatment applied[6]	Corn 1st year 9 crops	Corn 2d year 9 crops	Corn 3d year 9 crops		Soybeans 9 crops
RP	51.9	44.0	41.3		20.0
R	45.5	39.9	35.2		19.2
M	50.1	42.1	33.5		(1.59)
MP	54.5	46.7	42.0		(1.66)

[1]Results from Series 300 and 800 are omitted on account of variation in soil type.
[2]Soybeans when clover fails.
[3]Only seven crops with limestone.
[4]Only one crop with limestone.
[5]Average of five crops.
[6]All phosphorus plots received ½ ton per acre of limestone in 1903.

TABLE 5.—COMPARING PRODUCTION OF CORN IN THREE DIFFERENT ROTATION SYSTEMS
ACRE YIELDS FROM PLOTS ON THE UNIVERSITY SOUTH FARM
Twelve-Year Average (1908-1919)—Bushels per acre

Rotation	Wheat-corn-oats-legume[1]	Corn-corn-oats-legume[2]		Corn-corn-corn-legume[3]		
Treatment	Corn	1st Corn	2d Corn	1st Corn	2d Corn	3d Corn
Organic manures	55.8	53.3	46.0	47.8	41.0	34.3
Organic manures, phosphorus	63.2	56.6	52.3	53.2	45.3	41.6

[1]Clover 3 crops, and soybeans 7 crops.
[2]Clover 5 crops, and soybeans 5 crops.
[3]Soybeans 9 crops.

On the whole, the "residues" have not returned yields quite so high as those produced by the manure treatment; but, as remarked above in the discussion of the Davenport plots, the residues system has probably been at a disadvantage thru frequent clover failures. On the North-Central rotation, where conditions seem to have been more favorable for clover, there is very little difference between the effect of manure and of residues.

Residues plowed under
Yield: 35.2 bushels per acre

Residues and rock phosphate
Yield: 50.1 bushels per acre

FIG. 3.—WHEAT ON THE UNIVERSITY SOUTH FARM IN 1911

In the rotation system in which limestone is being applied, no benefit of consequence to any of the crops except oats appears from the use of this material. The test, however, has hardly been of sufficient duration to warrant final conclusions; and furthermore, the comparison may be somewhat impaired by a possible residual effect of the small application of limestone made in 1903 to all the phosphorus plots.

The results obtained from the use of phosphorus are important because this element has been applied to these plots solely in the form of raw rock phosphate. The figures in almost every case show an increase in yield where the phosphorus has been applied, and in most cases this increase is very pronounced. The wheat is especially responsive to phosphorus.

The records furnish some interesting comparisons of corn yields produced under different systems of cropping. Table 5 gives a general summary of the corn yields only, in which the results from the residues and manure treatments are averaged together as "organic manures." The highest annual acre-yields are found where corn occurs but once in a rotation. Where corn is grown twice in succession, the annual acre-yields are less; and where corn occurs three times, there is a further reduction. Also, the first crop of corn within a rotation produces more than the second, and the second crop yields more than the third. These are useful facts for consideration in connection with problems of general farm management.

YELLOW-GRAY SILT LOAM

Yellow-gray silt loam exhibits an important variation with respect to limestone content. In some areas, altho limestone may be altogether absent in the surface stratum it is found in abundance at a short distance beneath the surface. Accordingly, variations in response to soil treatment are exhibited by different experiment fields located on this type. In view of this discrepancy it is thought well to introduce here the records of two fields, that are representative of the type but which show a marked diversity in results, one in northern Illinois and one in the southern part of the state.

The Antioch field is located on the late Wisconsin glaciation, in Lake county, close to the Wisconsin border. The field was started in 1902, with but a single series of ten plots, under a rotation of corn, corn, oats, and wheat; but beginning with 1911 the rotation has been wheat, corn, oats, and clover. It was started in order to learn as quickly as possible what effect would be produced by the addition to this type of soil of nitrogen, phosphorus, and potassium, used singly and in combination. These elements were all applied in commercial form until 1911, after which the use of commercial nitrogen was discontinued and crop residues were substituted in its place. Nitrogen was supplied in the earlier years in 800 pounds per acre of dried blood. Phosphorus is applied in 200 pounds of steamed bone meal, and potassium in 100 pounds of potassium sulfate. At the beginning, 470 pounds of slaked lime was applied; but since 1912 limestone has been applied at the rate of 1,000 pounds per acre per year.

Table 6 presents, in summarized form, the results from the Antioch field. Because of an abnormality in Plot 1, the results from this plot are not considered. The data show that phosphorus is the one element standing out prominently as producing consistently beneficial results. Potassium applied in addition to phosphorus has, on the whole, not produced profitable results. Also, the

TABLE 6.—ANTIOCH FIELD: YELLOW-GRAY SILT LOAM, TIMBER SOIL; LATE WISCONSIN GLACIATION

Average Annual Yields—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Corn 8 crops	Oats 5 crops	Wheat 4 crops	Clover seed 2 crops
1	0	23.9	32.3	15.8	.50
2	L	21.3	26.8	13.2	.30
3	LR	21.3	29.9	20.6	.33
4	LP	30.7	43.6	36.7	1.08
5	LK	23.7	27.8	19.2	.57
6	LRP	33.8	43.3	33.3	.57
7	LRK	24.3	26.9	20.8	.59
8	LPK	25.1	38.2	30.9	1.26
9	LRPK	38.3	42.6	28.0	.33
10	RPK	38.4	44.7	30.2	.67

Lime applied and residues plowed under

Lime and phosphorus applied

FIG. 4.—CLOVER IN 1913 ON ANTIOCH FIELD

results are unfavorable for the application of limestone. Limestone, however, is abundant in the subsoil of this type in the region of this field.

The Raleigh experiment field is located on the lower Illinoisan glaciation, in southern Illinois, in Saline county. This field is laid out into four series of ten plots each, under a rotation of wheat, corn, oats, and clover. The treatments, along with the summarized results, are given in Table 7.

Manure, limestone, phosphorus
Yield: 61 bushels per acre

Nothing applied
Yield: 15 bushels per acre

FIG. 5.—CORN ON RALEIGH FIELD IN 1920

TABLE 7.—RALEIGH FIELD: YELLOW-GRAY SILT LOAM, TIMBER SOIL; LOWER ILLINOISAN GLACIATION

Average Annual Yields—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Corn 10 crops	Oats 10 crops	Wheat 6 crops	Clover 4 crops	Soybeans 4 crops
1	0	17.3	10.4	5.8	(.26)	(.65)
2	M	29.7	13.0	7.7	(.31)	(.81)
3	ML	40.9	20.0	21.0	(1.08)	(1.08)
4	MLP	41.2	20.3	21.5	(1.32)	(1.24)
5	0	17.3	10.3	7.0	(.00) .01[2]	2.3
6	R	20.1	12.8	8.4	(.00) .01[2]	3.0
7	RL	34.9	21.5	18.8	(1.60)[1] .10[2]	5.8
8	RLP	36.5	22.7	21.2	(1.61)[1] .09[2]	6.8
9	RLPK	41.9	23.6	22.4	(1.79)[1] .12[2]	6.0
10	0	19.6	11.6	6.5	(1.06)	(.57)

[1]One crop only (1920).
[2]Average of two crops.

The outstanding feature of these results is the effect of limestone. Altho manure alone produces a substantial increase, especially in the corn crop, when limestone is added a remarkable increase is found in all crops. A most important fact is that the organic matter can be effectively built up thru the use

of crop residues, with the application of limestone, so that the crop yields are practically as high under this "grain system" of farming as where manure is used.

Phosphorus thus far has given only moderate returns in increased crop yields, but with an increasing quantity of organic matter and nitrogen it is probable that the phosphorus applications will show up more favorably on subsequent crops. As to the use of potassium, it is to be noted that aside from an increase of 5.4 bushels of corn in the residues system, the beneficial effect has not been sufficient to justify the use of this material.

In accounting for the discrepancy in the response to limestone on these two fields, the fact is to be considered that the Antioch field is located on the late Wisconsin glaciation, where the subsoil contains large quantities of limestone; while the Raleigh field represents the lower Illinoisan glaciation, the soil of which is very acid to a great depth.

In view of these variations, a general recommendation for a complete treatment for soil of this type, that will apply to all localities, cannot be given out until more information is acquired.

Fortunately, however, each farmer can determine for himself the need of limestone for his land by applying the simple tests for the presence of carbonates and soil acidity, as explained under the discussion of limestone on page 29 of the Appendix.

Phosphorus, which has paid well on the Antioch field, and has given doubtful returns thus far at Raleigh, has varied considerably in its effect when used on other fields located on this same type of soil. In this situation, therefore, the present suggestion would be that each farmer might well try out phosphorus on his own land, on a limited scale, and be guided by the outcome of his experience. The low phosphorus content of the surface stratum of this soil is an indication that in a system of permanent agriculture the time is not far off when phosphorus will become a limiting element to crop production, and the wise farmer will watch carefully the indications and be ready to make timely provision for this need.

Deep Peat

As representing the deep peat type of soil, the results are introduced from an experiment field conducted at Manito in Mason county during the years 1902 to 1905 inclusive.

There were ten plots receiving the treatments indicated in Table 8.

The results of the four years' tests, as given in Table 8, are in complete harmony with the information furnished by the chemical composition of peat soil. Where potassium was applied, the yield was from three to four times as large as where nothing was applied. Where approximately equal money values of kainit and potassium chlorid were applied, slightly greater yields were obtained with the potassium chlorid, which, however, supplied about one-third more potassium than the kainit. On the other hand, either material furnished more potassium than was required by the crops produced.

The use of 700 pounds of sodium chlorid (common salt) produced no appreciable increase over the best untreated plots, indicating that where potassium is itself actually deficient, salts of other elements cannot take its place.

TABLE 8.—MANITO FIELD: DEEP PEAT
Corn Yields—Bushels

Plot No.	Soil treatment for 1902	Corn 1902	Corn 1903	Soil treatment for 1904	Corn 1904	Corn 1905	Four crops
1	None	10.9	8.1	None	17.0	12.0	48.0
2	None	10.4	10.4	Limestone, 4000 lbs.	12.0	10.1	42.9
3	Kainit, 600 lbs	30.4	32.4	Limestone, 4000 lbs.. Kainit, 1200 lbs	49.6	47.3	159.7
4	Kainit, 600 lbs.. Acidulat'd bone, 350 lb.	30.3	33.3	Kainit, 1200 lbs.. Steamed bone, 395 lbs.	53.5	47.6	164.7
5	Potassium chlorid, 200 lbs	31.2	33.9	Potassium chlorid, 400 lbs	48.5	52.7	166.3
6	Sodium chlorid, 700 lbs.	11.1	13.1	None	24.0	22.1	70.3
7	Sodium chlorid, 700 lbs.	13.3	14.5	Kainit, 1200 lbs	44.5	47.3	.....
8	Kainit, 600 lbs	36.8	37.7	Kainit, 600 lbs	44.0	46.0	164.5
9	Kainit, 300 lbs	26.4	25.1	Kainit, 300 lbs	41.5	32.9	125.9
10	None	14.9[1]	14.9	None	26.0	13.6	69.4

[1]Estimated from 1903; no yield was taken in 1902 because of a misunderstanding.

Applications of 2 tons per acre of ground limestone produced no increase in the corn crops, either when applied alone or in combination with kainit, either the first year or the second.

Reducing the application of kainit from 600 to 300 pounds for each two-year period reduced the yield of corn from 164.5 to 125.9 bushels. The two applications of 300 pounds of kainit (Plot 9) furnished 60 pounds of potassium for the four years, an amount sufficient for 84 bushels of corn (grain and stalks). Attention is called to the fact that this is practically the difference between the yield of Plot 9 (125.9 bushels) and the yield obtained from Plot 2 (42.9 bushels), the poorest untreated plot.

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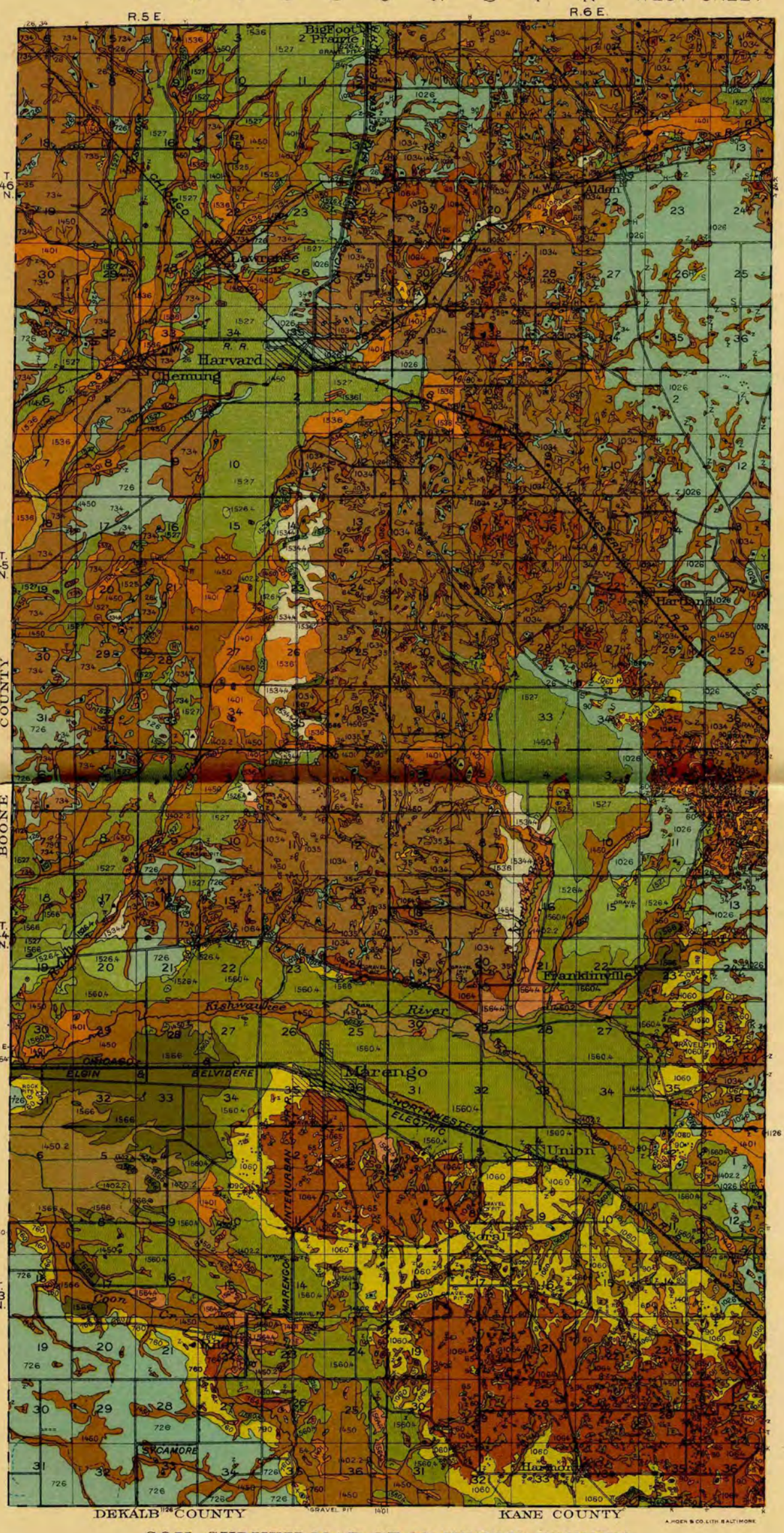

LEGEND

UPLAND SOILS

700 Iowan glaciation

1000 Late Wisconsin moraines

1200 Late Wisconsin intermorainal areas

(a) UPLAND PRAIRIE SOILS

- 26 Brown silt loam
- S 60 Brown sandy loam
- 90 Gravelly loam
- Small areas of gravelly loam
- Small areas of stony loam

(b) UPLAND TIMBER SOILS

- H 34 Yellow-gray silt loam
- A 35 Yellow silt loam
- K 64 Yellow-gray sandy loam
- 65 Yellow sandy loam

(c) 1500 TERRACE SOILS

- Y 1527 Brown silt loam over gravel
- A 1526.4 Brown silt loam on gravel
- 1525 Black silt loam
- 1566 Brown sandy loam over gravel
- A 1560.4 Brown sandy loam on gravel
- T 1536 Yellow-gray silt loam over gravel
- A 1534.4 Yellow-gray silt loam on gravel
- 1567 Yellow-gray sandy loam over gravel
- E 1564.4 Yellow-gray sandy loam on gravel
- 1528 Brown-gray silt loam on tight clay
- 1590 Gravelly loam

(d) 1400 SWAMP AND BOTTOM-LAND SOILS

- Z 1450 Black mixed loam
- 1450.2 Black mixed loam on sand
- PT 1401 Deep peat
- 1402.2 Medium peat on sand
- 1454 Mixed loam

Scale 0 ¼ ½ 1 2 Miles

SOIL SURVEY MAP OF McHENRY COUNTY

UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION

W I S C O N S I N

EAST SHEET

LEGEND

UPLAND SOILS

700 Iowan glaciation

1000 Late Wisconsin moraines

1200 Late Wisconsin intermorainal areas

(a) UPLAND PRAIRIE SOILS

26 Brown silt loam

S 60 Brown sandy loam

90 Gravelly loam

Small areas of gravelly loam

Small areas of stony loam

(b) UPLAND TIMBER SOILS

H 34 Yellow-gray silt loam

A 35 Yellow silt loam

K 64 Yellow-gray sandy loam

65 Yellow sandy loam

(c) 1500 TERRACE SOILS

Y 1527 Brown silt loam over gravel

A 15264 Brown silt loam on gravel

1525 Black silt loam

1566 Brown sandy loam over gravel

C 15604 Brown sandy loam on gravel

T 1536 Yellow-gray silt loam over gravel

▲ 15344 Yellow-gray silt loam on gravel

1567 Yellow-gray sandy loam over gravel

E 15644 Yellow-gray sandy loam on gravel

1528 Brown-gray silt loam on tight clay

1590 Gravelly loam

(d) 1400 SWAMP AND BOTTOM-LAND SOILS

Z 1450 Black mixed loam

1450.2 Black mixed loam on sand

π 1401 Deep peat

1402.2 Medium peat on sand

1454 Mixed loam

Scale

0 ¼ ½ 1 2 Miles

R.7 E. R.8 E. R.9 E.

T. 46 N.

T. 45 N.

T. 44 N.

T. 43 N.

LAKE COUNTY

Hebron

Richmond

Spring Grove

Greenwood

Ringwood

Johnsburg

Fox River Grove

Terra Cotta

Richfield

Crystal Lake

Huntley

Algonquin

CHICAGO NORTHWESTERN

CHICAGO MILWAUKEE

WOODSTOCK CHICAGO

NORTHWESTERN

FOX RIVER

KANE COUNTY

COOK CO.

A. HOEN & CO. LITH. BALTIMORE

SOIL SURVEY MAP OF McHENRY COUNTY

UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION